

REFORESTATION OF DEGRADED FOREST RESERVES IN GHANA



Document Prepared by CMO International

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The objective of the project is to carry out reforestation of 20,000 hectares in degraded forest reserves located in Ghana.

Relevant implementations dates: The initial project commenced on 1st March 2008, and, as of 31 July 2023, has resulted in the reforestation of 1,373¹ hectares in the Asubima Forest Reserve (Akumadan). This constitutes the first project instance of the grouped project. The second instance of the grouped project started on 1st March 2011, resulting in the reforestation of 1,802² hectares in Afrensu Brohuma Forest Reserve (Akumadan). The third instance of the grouped project commenced on 1st March 2013, and 8, 908³ hectares have been planted in the Tain II Forest reserve (Berekum).

No new project areas have been established. No new instances were added to the project in this monitoring period. The newly planted areas are part of the existing TAIN II instance and presented in Table 1: Summary of activities in the monitoring period.

Emission reductions: During the monitoring period a total of 413,179t CO₂ GHG emission removals have been generated⁴.

Main changes compared to the previous monitoring period: During the current monitoring period, newly planted areas in the Asubima (Akumadan) and Tain II (Berekum) Reserves have been established. At the time of data collection (January to May 2023) for this monitoring report, the 2023 planting season had not been completed and hence the 2023 planted areas were not yet consolidated. Nonetheless, no new areas have been established in other regions of the project area. Routine management operations, such as pruning, thinning, and forest protection, have been performed while systematically monitoring the potential risks through the monitoring system as specified in the Project Description Document.

¹ The total area considered in the carbon calculations are less (1,322 ha), because the newly planted area in the monitoring period is not considered for carbon sequestration yet.

² The total area considered in the carbon calculations are less (1,798 ha), because the newly planted area in the monitoring period is not considered for carbon sequestration yet.

³ The total area considered in the carbon calculations are less (8,079 ha), because the newly planted area in the monitoring period is not considered for carbon sequestration yet.

⁴ Refer to 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx 1, Tab EP overview, cell I5

A summary of the activities in the monitoring period are provided in Section 4.3, under the Monitoring Plan.

Audit History

The following table presents the audit history of the project.

Audit Type	Period	Program	VVB Name	Number of years
Validation	17-January-2013	VCS	SCS Global Services	N/A
Verification	01-March-2008-01-August-2012	VCS	SCS Global Services	4 years 5 months
Verification	02-August-2012 - 01-April-2018	VCS	Rina Services SPA	5 years 8 months
Verification	02-April-2018 - 30-June-2019	VCS	Rina Services SPA	1 year 3 months
Verification	01-August-2019 - 31-July-2021	VCS	Rina Services SPA	2 years
Verification	01-August-2021 - 31-July-2023	VCS	AENOR	2 years
Total				15 years 4 months

1.2 Sectoral Scope and Project Type

The sectoral scope: Scope 14 - Agriculture, Forestry and Other Land Uses (AFOLU).

Project Type: Afforestation, Reforestation, Revegetation (ARR) type, more specifically Reforestation and Revegetation.

The project is classified as a grouped project because new areas will be included in the future.

1.3 Project Proponent

Organization name	FORM Ghana Ltd.
Contact person	Mr. Willem Fourie
Title	Managing Director
Address	PO Box SYI 211, Sunyani, Ghana

Telephone	+233 544 441 440
Email	w.fourie@formghana.org

1.4 Other Entities Involved in the Project

Organization name	Sustainable Forestry Investments B.V. (SFI)
Role in the Project	Owner and shareholder of FORM Ghana, but no active role in VCS implementation.
Contact person	Mr. Paul Hol
Title	CEO
Address	Hooflaan 1, 1401, EA Bussum, The Netherlands
Telephone	+31 (0)38 444 89 90
Email	info@sfi.com

1.5 Project Start Date

The project initiation date (start date) of 01-March-2008 was selected based on the eligibility criteria stipulated by the issuance body. The project activities that are up to five years old are considered for inclusion in the carbon credit calculation. Since the initial planting activities (2001-2007) were beyond the crediting period, they were excluded from the project. The commencement date of March 1st was strategically chosen to precede the 2008 planting activities to ensure their complete incorporation into the project. The chosen start date aligns with the project's objectives and facilitates the accurate measurement and reporting of the carbon credits generated.

1.6 Project Crediting Period

Start date: 01-March-2008
 End date: 29-February-2048
 Total number of years: 40

1.7 Project Location

There is no change to the project location. The Asubima and Afrensu Brohuma Forest Reserves are situated in the dry, semi-deciduous forest zone at about 100 km north of

Kumasi in the Ashanti region in Ghana (Figure 1). It falls under the authority of the Offinso Forest District.



Figure 1: Location of the Form Ghana plantations in Asubima and Afrensu Brohuma and Tain II Forest Reserves

Asubima Forest Reserve and Afrensu Brohuma Forest Reserve are two adjacent Forest Reserves. Tain lies some 100 km to the east located in Berekum District, Bono Region. The Form Ghana land covers only a portion of these three Forest Reserves. The land leases are in the south-eastern part of Asubima Forest Reserve, the north-eastern part of Afrensu Brohuma Forest Reserve and the northeastern part of Tain II reserve.

The first project instance is the Form Ghana plantation in Asubima Forest Reserve. The second project instance is the Form Ghana plantation in Afrensu Brohuma Forest Reserve. The map below shows the boundaries of the project area. In Asubima an established pilot teak plantation (53 ha) in 2001 and a patch of farmer's teak (117 ha) have been excluded from the scope, because they have been established before the project starting date. The same applies to some patches of farmer's teak (30 ha) in Afrensu Brohuma.

Explanation of the naming convention applied to the instances/areas in the project

Throughout the Monitoring Report and the supporting documentation, such as the stakeholder communication documents, in many cases we refer to Tain II as Berekum, because Tain II falls within the Berekum District. Similarly, the Afrenso Brohuma and Asubima plantations are referred to as Akumadan.

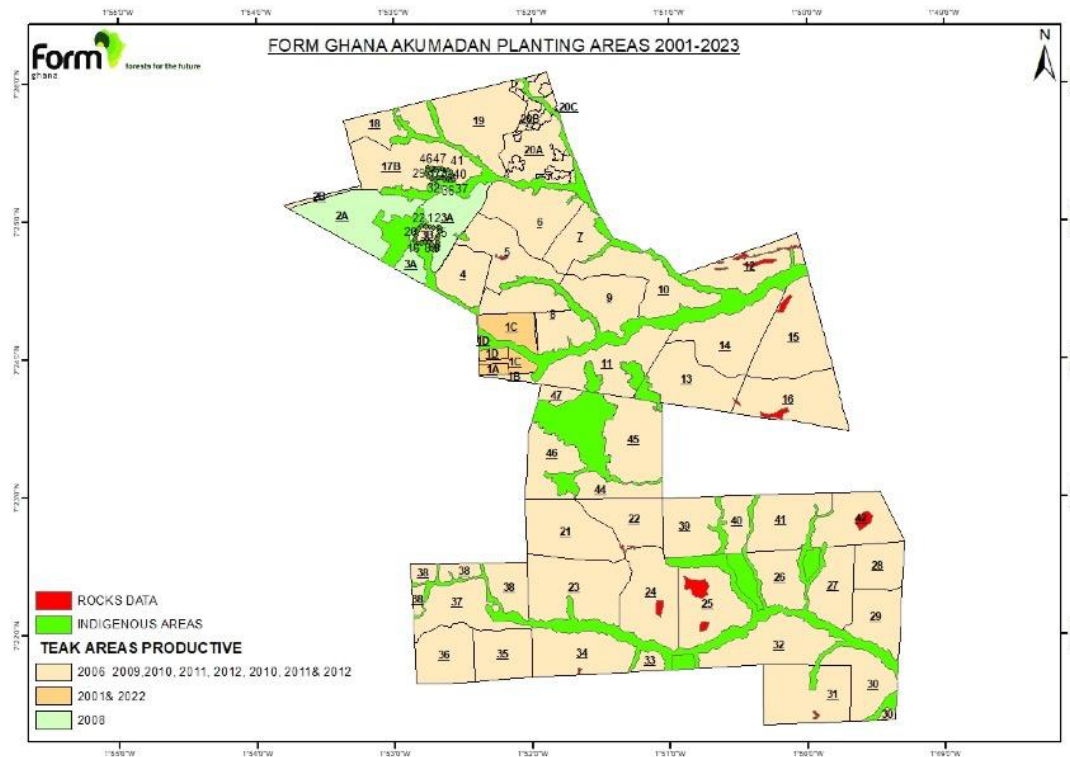


Figure 1: Map of project area in Asubima and Afrensu Brohuma Forest Reserves (Akumadan)

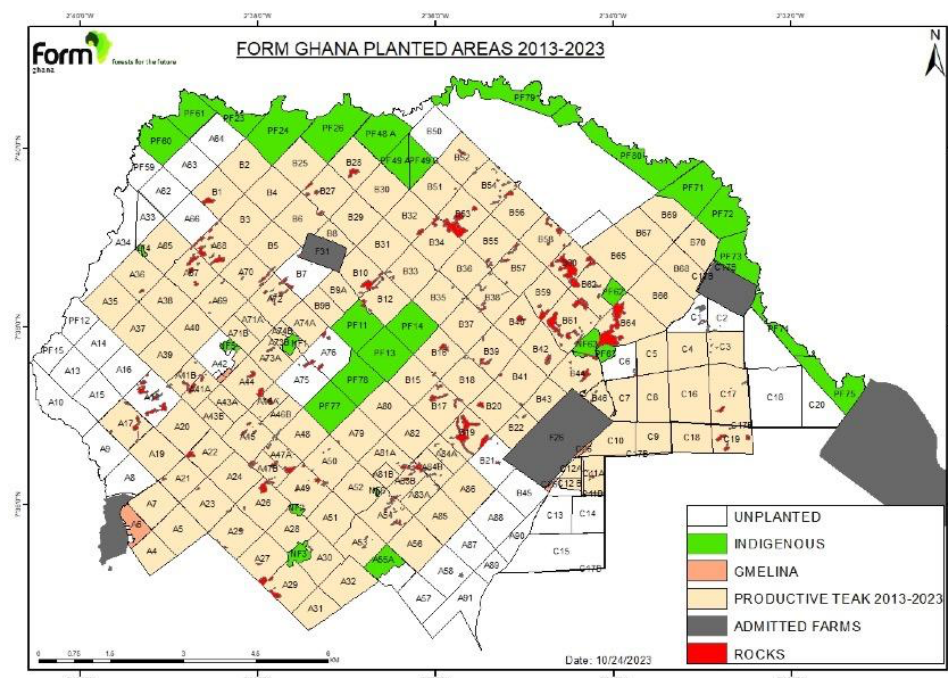


Figure 2: Map of project area in Tain II Forest Reserve (Berekum)

1.8 Title and Reference of Methodology

The CDM consolidated methodology AR-ACM0003: Afforestation and reforestation of lands except wetlands --- Version 02.0 is applied.

In addition, the following tools are applied by the project:

- Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities (Version 01)
- Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities (Version 01)
- Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity (Version 02.0)
- Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Version 04.2)
- Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities (Version 01.1.0)
- VCS AFOLU Non-Permanence Risk Tool (Version 4.0)

1.9 Participation under other GHG Programs

The project *Reforestation of degraded Forest Reserves in Ghana* is not registered under any other GHG program, nor are the areas under this project used in other GHG programs under the same or a different name.

1.10 Other Forms of Credit and Supply Chain (Scope 3) Emissions

Emission Trading Programs and Other Binding Limits: The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

Other Forms of Environmental Credit: Reforestation of degraded Forest Reserves in Ghana does not collect any other credits apart from VCS.

Supply Chain (Scope 3) Emissions: Form Ghana confirms that our carbon project activities do not impact the carbon emissions of goods and services in a supply chain and, therefore, Scope 3 emissions. To confirm this, Form Ghana has communicated with the buyers of the product. Evidence of the emails sent to the buyers are attached as an appendix.

1.11 Sustainable Development Contributions

Indicators align with the following items in the NDC's priorities⁵:

- Build resilient economies and societies;
- Enhance landscape restoration.

The project contributes to the achievement of some listed aims described by Ghana's Ministry of Lands and Natural Resources, who addresses the degradation of natural resources and ensure the effective management of these for sustainable development in Ghana⁶:

- implements sustainable forest management according to the principles of Forest Stewardship Council⁷ ;
- has a benefit sharing agreement⁸;
- raises public awareness with surrounding communities through community engagement,

⁵ Ghana's Updated Nationally Determined Contribution to the UNFCCC_2021.pdf, https://unfccc.int/sites/default/files/NDC/2022-06/Ghana%27s%20Updated%20Nationally%20Determined%20Contribution%20to%20the%20UNFCCC_2021.pdf

⁶ <https://mlnr.gov.gh/index.php/the-ministry/>

⁷ Forest Stewardship Council, 2015

⁸ Forestry Commission, 2009; Forestry Commission, 2012; Forestry Commission, 2013

- and is part of the private sector managing parts of national Forest Reserves.

The Form Ghana project is committed to SDGs, as described in table 1 below:

Table 1 : Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	By planting 331.3 ha during the monitoring period, the project sequesters 413,179 tCO ₂ from the atmosphere.	An estimated 2,729,257 tCO ₂ will be sequestered over the lifetime of the project (VCS Form Ghana Project Description 19072019.pdf).
2)	15.2	By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	Implemented activities to increase	By planting 338.15 ha during the monitoring period.	An estimated 20,000 hectares have been demarcated to be reforested or revegetated over the lifetime of the project.

2 SAFEGUARDS

2.1 No Net Harm

Form Ghana confirms that there are no potential negative environmental and socio-economic impacts as a result of the project, considering the project activity, which is based on planting a new forest on degraded land, as described under section 2.3.

A comprehensive Socio-Economic Impact Assessment (SEIA) was undertaken for all project locations with the aim of integrating environmental and socio-economic components in management decisions at the earliest stages of the program. The SEIA has enabled the development of plans to mitigate negative effects and enhance positive effects on existing conditions. The SEIA has identified no major negative impacts of the proposed project.

2.2 Local Stakeholder Consultation

The stakeholder engagements continued in this monitoring period, building on the meetings and engagements held in the previous monitoring periods. A list with stakeholder meetings was provided to the VVB during the site visit, including information regarding specific meetings held, the locations and the main topics and outcomes of the meetings.

Items that are covered during the meetings include the results of project implementation and monitoring.

The process of VCS verification and the information to the stakeholders about the VVB site visit

The CEO of Form Ghana informs the stakeholders of the VVB site visit and the verification process in advance and arranges any meetings that the VVB requests.

The results of project implementation, including the results of monitoring.

Updates on the ongoing activities of Form Ghana are discussed at the stakeholder meetings⁹.

Changes, where relevant, to relevant laws and regulations covering workers' rights in the host country.

During the monitoring period, there were no changes to risks, costs or benefits to the stakeholders since the conclusion of the previous monitoring period, and therefore, there was no information to share with stakeholder in this regard.

Relevant changes to relevant laws and regulations covering workers' rights in the host country.

No new laws or regulations were promulgated in Ghana since the conclusion of the previous monitoring period, and therefore, there was no information to share with stakeholder in this

⁹ For example, refer to "First Stakeholders meeting Berekum -19052023.pdf" and "First Stakeholders Meeting Akumadan 16052023.pdf"

regard. If any changes occur to laws and regulations on a national level, the Human Resources Department will share that information and ensure that it is implemented.

A. Verification Site visit and VVB engagement

Aenor was engaged to conduct the verification and the agreement was signed on 13 January 2023 and the site visit was conducted between 4 to 6 September 2023. The CEO of Form Ghana informs the stakeholders of the VVB site visit and the verification process in advance and also arranges any meetings that the VVB requests.

B. Ongoing communication with stakeholders

How due account of all and any input received during ongoing communication has been taken.

The following sections provide insight into the processes used to communicate and consult with local stakeholders during the monitoring period on an on-going basis. It is fair to say that no conflicts arose between the Form Ghana and local stakeholders, but any comments and requests are dealt with in a transparent and timeous manner. If conflicts arise, these will be resolved via the established grievance redress procedure as presented to the VVB.

The procedures or methods used for engaging local stakeholders

C. Stakeholder Meetings

Stakeholders are invited to attend and participate in meetings by invitation letters. Protocol 6 describes the procedure by which stakeholders are identified.

The level of engagement that Form Ghana use to communicate and consult with stakeholders are described in the table below:

Level of engagement	Methods of engagement
Information sharing	• Notification letters • Advert in newspaper • Newsletters • Information available on website • Presentations and posters • School visits
Active engagement	Relevant methods used for 'Information sharing', complemented with: • Stakeholder meetings • Community sensitization meetings • Hand delivery of documents • Brochure • Intercropper / outgrower meetings
In depth engagement	Relevant methods used for 'Active engagement', complemented with: • One on one briefing and informant meetings

	• Personal telephone calls
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Different stakeholders will be approached in different ways, depending on their access to facilities such as media, mail, internet and telephone. Also, the interest of stakeholders in the project differs. Some are directly affected as they farm on the land being planted, whereas others will find employment with the project or are less involved but are interested. Because of this Form Ghana¹⁰:

- Proactively plans engagement with specific objectives and desired outcomes.
- Uses adapted methods to suit the needs of stakeholders and enable cooperative participation.
- Builds capacity among stakeholders to improve their ability to interpret the information.
- Provides timely feedback on whether and how the stakeholder's inputs were incorporated into company activities.

To ensure effective communication and engagement with the local communities, Form Ghana organizes separate meetings for the Akumadan plantations and the Tain II (Berekum) plantations. These meetings are held at least once a year and are an important platform for Form Ghana to interact with the stakeholders, including farmers, community leaders, and other relevant parties. Through these meetings, the stakeholders are well informed about the project, its activities, and the benefit share they are entitled to. Additionally, they are educated on their rights and obligations in relation to the plantations. In preparation for the fire season, specific stakeholder engagement is conducted to help farmers protect their farms from fire. Form Ghana's emphasis on stakeholder engagement has resulted in a positive outcome, where the local communities are well-informed and actively participate in the project's activities.

D. Discussions during stakeholder meetings

During stakeholder engagements, several pertinent subjects have been (and continue to be) discussed in relation to the project at hand. These include:

- an analysis of the outcomes of project implementation, including the results of monitoring efforts.
- any alterations to risks, costs, and benefits that may impact local stakeholders are diligently considered.
- changes to relevant laws and regulations concerning workers' rights in the host country have also been carefully evaluated.
- Security issues are also on the agenda of meetings and stakeholders have the opportunity to raise any issues if needed.

¹⁰ Refer to "P 06 Stakeholder Management - July 2021.docx"

Through these discussions, stakeholders have been able to gain a comprehensive understanding of the project, its impact, and the measures in place to ensure accountability and transparency.

E. Policy documentation guiding the local stakeholder consultation process

- *P 06 Stakeholder Management–July 2021.docx*: This procedure identifies the stakeholders of Form Ghana and describes how stakeholders are engaged.
- *P 07 CRM.docx*: This document describes how grievances are dealt with and how grievances are redressed.
- *P28 Community Development – 2019.doc* - This plan describes the community development activities that Form Ghana undertakes.

The procedures or methods used for documenting the outcomes of the local stakeholder communication.

Minutes¹¹ are kept by Form Ghana for all meetings, in most cases photos are also taken and will be submitted during verification site visit. The minutes record all concerns or comments raised by stakeholders and their immediate response from Form Ghana representatives. Where relevant, the minutes reflect the response from Form Ghana on concerns raised in prior meetings.

During the next meeting, the minutes of the previous meeting are reviewed, and action items and follow-ups are checked to ensure that action items are addressed between the meetings.

Some of the formal stakeholder meetings and engagements are presented in the table below. There are more ad hoc community engagements from time to time, but the list below reflects the formal meetings or events where reports are compiled.

Table 3: Formal stakeholder engagements during the monitoring period

Date	Location	Activity	Reference document
11/06/2021	Berekum (Tain II)	Green Ghana Day	Green Ghana Day 2021.pdf
13/08/2021	Berekum (Tain II)	First Stakeholders meeting in 2021	First Stakeholders meeting Berekum-13082021.pdf
04/03/2022	Berekum (Tain II)	First Stakeholders meeting in 2022	First Stakeholders meeting Berekum - 04032022 docx.pdf

¹¹ For example, refer to “First Stakeholders meeting Berekum -19052023.pdf” and “First Stakeholders Meeting Akumadan 16052023.pdf”

Date	Location	Activity	Reference document
06/05/2022	Berekum (Tain II)	Integrated community fire management project	REPORT-ICFMP-2021 2022 FIRE SEASON (06 052022).pdf
10/06/2022	Berekum (Tain II)	2nd Green Ghana Day Project on Friday, 10th June 2022.	GGD PROJECT 2022 31012023.pdf
09/12/2022	Berekum (Tain II)	Second Stakeholders meeting in 2022	Second Stakeholders Meeting Berekum 09122022.pdf
22/12/2022	Berekum (Tain II)	Commissioning of Mechanized Borehole Project at Asantekrom	Report-Commissioning of Mechanized Borehole to Asantekrom Community.pdf
27/03/2023 – 29/03/2023	Berekum (Tain II)	Grading of kotaa-ampenkrom and domeabra-akrofro roads	REPORT - Ampenkrom Domeabra Road Maintenance.pdf
25/01/2023 to 7/04/2023	Berekum (Tain II)	Footbridge construction at A santekrom	Report-Construction of Asantekrom Footbridge.pdf
02/05/2023	Berekum (Tain II)	Integrated community fire management project	REPORT-ICFMP-2022 2023 FIRE SEASON.pdf
19/05/2023	Freeman Methodist Church, Berekum (Tain II)	First biannual stakeholders meeting Berekum for 2023	First Stakeholders meeting Berekum - 19052023.pdf
15th - 24th September, 2021	Akumadan	Stakeholder Engagement	Stakeholder Engament on Harvesting-Akumadan (002).pdf
01/03/2022	Akumadan	First Stakeholders meeting in 2022	First Stakeholder meeting Akumadan 01032022.pdf
06/12/2022	Akumadan	Second Stakeholders meeting in 2022	Second Stakeholders Meetings Akumadan 06122022.pdf

Date	Location	Activity	Reference document
16/05/2023	Akumadan	First biannual stakeholders meeting Akumadan for 2023	First Stakeholders Meeting Akumadan 16052023.pdf

The following table is a summary of reports compiled by Form Ghana to reflect engagements with stakeholders over a longer period of time.

Date	Activity Description	Reference document
Published in November 2021	Annual Social Report for the year 2021 was published. It captures all social activities which were carried out in 2021. This involves: • Social impact monitoring (Akumadan & Berekum) • Intercropping activities	Annual Social monitoring Report (Berekum and Akumadan)11112021.pdf
Published in November 2022	This report provides a registry of the intercropping farmers listed (registered). Information regarding gender representation is also provided.	Progress Report Intercropping 2016-2022.pdf
Published in November 2022	Annual Social Report for the year 2022 was published. It captures all social activities which were carried out in 2022. This involves: • Social impact monitoring (Akumadan & Berekum) • Intercropping activities • Tain II (Berekum) landscape restoration project	Annual social report (Akumadan Berekum) 2022.pdf

F. Management of Complaints/Conflicts

Form Ghana takes all complaints and conflict situations from stakeholders seriously, and therefore has established a Grievance Redress Mechanism, which is described in Protocol 7¹². Through this mechanism, they ensure that any concerns raised are addressed in a timely and transparent manner. Over the previous monitoring period, they received feedback from stakeholders who wished to see more people from fringe communities included in worker and firefighter recruitment. They took this feedback seriously and subsequently implemented measures to increase the inclusion of individuals from these communities during our recruitment

¹² Refer to document "P 07 CRM.docx"

processes. They remain committed to engaging with our stakeholders and addressing their concerns through our Grievance Redress Mechanism.

There were no outstanding conflicts during this monitoring period.

G. Conclusion

During this monitoring period, stakeholders were actively engaged in the consultation process through stakeholder meetings. These meetings were held at various intervals for both Berekum, and Akumadan. All meetings were conducted in neutral venues, such as meeting halls and churches, and were announced using invitation letters. The selection of stakeholders to receive an invitation was based on Protocol 6. Attendance lists and minutes for all meetings were documented and kept by Form Ghana and included photos of the meetings. The minutes reflect all concerns or comments raised by stakeholders and the immediate response from Form Ghana representatives. They also provide insight into how Form Ghana has responded to concerns and items raised during earlier meetings.

2.3 AFOLU-Specific Safeguards

Local stakeholders are identified by assessing the following categories of stakeholders and are listed in the following table:

<u>Stakeholder category</u>	<u>Stakeholder identified</u>	<u>Negative impacts during the monitoring period</u>	<u>Mitigation action during the monitoring period</u>
National Government	Forestry Commission, Environmental Protection Agency, Water Resources Commission, Department of Factories Inspectorate	No negative impacts	<u>Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.</u>
Regional Government	Forestry Commission, Environmental Protection Agency, Water Resources Commission, Department of Factories Inspectorate	No negative impacts	<u>Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.</u>
Local Government	District Assembly, MoFA,	No negative impacts	<u>Ongoing communication was upheld and it was not</u>

	District Forestry Office		<u>necessary to implement any activities to mitigate negative impacts.</u>
Traditional Landowners	Chiefs, Traditional Council, Stool lands	No negative impacts	<u>Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.</u>
Stakeholder Communities	Fringe communities	No negative impacts	<u>Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.</u>
Service Providers	Ghana National Fire Service (GNFS), National Commission for Civic Education (NCCE)	No negative impacts	<u>Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.</u>
Health/Educational Institution	Hospitals, Ghana Education Service, individual schools	No negative impacts	Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.
Funding/Donor organization	African Development Bank	No negative impacts	Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.
Certifying Organization	Forestry Stewardship Council	No negative impacts	Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.
Environmental NGOs	The local branches of IUCN, Tropenbos International and WWF	No negative impacts	Ongoing communication was upheld and it was not necessary to implement any activities to mitigate negative impacts.

Community access to non-timber forest products

By customary rules, local communities have traditionally had access to non-timber forest products (NTFPs) in natural forests. In addition, communities could access timber for development work by obtaining permits from the Forestry Service Division (FSD). However, it should be noted that the FSD is unable to grant permits for timber extraction within a plantation that is under lease by another party. The findings of impact assessments reveal that people interviewed derive very little or no economic value from forest products. Additionally, none of the respondents reported depending on the collection of NTFPs as their primary occupation. This can be attributed to the degraded state of the forest reserves, which limits the availability of NTFPs and timber.

Stakeholder involvement – Risks to stakeholders

A comprehensive Socio-Economic Impact Assessment (SEIA) was undertaken for all project locations (refer to SEIA Tain II.pdf and SEIA Asubima.pdf and SEIA Afrensu Brohuma 15/11/2012.pdf) with the aim of integrating environmental and socio-economic components in management decisions at the earliest stages of the program. The SEIA has enabled the development of plans to mitigate any possible negative effects and enhance positive effects on existing conditions. To ensure effective community participation, project proponents, private and government agencies have been invited to participate in the assessment and review of proposed actions.

The SEIA has identified no major negative impacts of the proposed project. To ensure regular updates and feedback, Form Ghana has committed to organizing at least two stakeholder meetings per year, with the possibility of organizing additional meetings if the need arises. Stakeholders are identified and invited based on a comprehensive stakeholder database that is regularly updated and verified prior to the organization of any meeting.

In 2018, an assessment was done to update the Socio-Economic Impact Mitigation Action Plan (SEIMAP) for the Form Ghana reforestation project (refer to “RAP Form Ghana - final report_27-11-2018.pdf”). In 2020, Form Ghana engaged CSIR-Forestry Research Institute of Ghana to conduct an independent compliance audit of the Resettlement Action Plan (RAP) for their reforestation project. The objectives of the RAP compliance audit were to assess the level of compliance of RAP implementation with the applicable requirements; to evaluate the effectiveness of the mitigation measures recommended and implemented; and draw lessons for future projects. A report with the outcome was submitted and is available to the VVB (refer to “RAP Compliance Audit Report_Form Ghana_CSIR-FORIG_06/04/2020.pdf”).

The processes used to communicate and consult with local stakeholders during the monitoring period, including any information about any conflicts that arose between the project proponent and local stakeholders and whether any such conflicts were resolved via the established grievance redress procedure.

Section 2.2 provides detail about selection of stakeholders and the ongoing communication with them. The following paragraphs elaborate even more on the procedures of communication to provide additional background.

Communication with Stakeholders

Form Ghana has an elaborate protocol that details the identification and categorisation of stakeholders, describes the procedures for maintaining the stakeholder database, describe

stakeholder analysis, the various stakeholder engagement methods, dispute settlements and managing perceptions.

Stakeholder meetings

Stakeholder meetings serve as a crucial mode of communication between Form Ghana and its stakeholders. As per the established plan, the company conducts at least one such meeting annually, wherein various stakeholder groups are represented. If deemed necessary, the company may organize additional meetings. All stakeholders on the list, for whom the meeting is deemed relevant, are invited prior to the meeting.

To maintain neutrality and avoid intimidation, the meeting is held in a neutral venue such as a church or town/village hall. Invitation letters are sent or delivered to the stakeholders, and communication regarding the meeting and venue is channeled through community contact persons. For stakeholders facing transportation difficulties, the company arranges transportation, such as groups of farmers.

The stakeholder meeting's agenda is crafted by identifying topics that require discussion with stakeholders and listing new information that has surfaced since the prior meeting, such as new reports, developments, and events in the field. A concise summary of the gathered information is drafted and distributed as a handout for the meeting.

During the meetings, people are encouraged to share their views. Views are then discussed during the meeting, and this is explicitly captured in the meeting minutes. Minutes of the stakeholder meetings are kept at the Form Ghana office. The minutes are discussed in management meetings.

Form Ghana aims to accomplish the following during stakeholder meetings:

1. Inform stakeholders of the company's management plan.
2. Facilitate the exchange and distribution of information between stakeholders.
3. Formulate and identify projects for the area with available funds.
4. Educate stakeholders about the company's Grievance Redress mechanism.

Managing grievances or conflict

While striving to prevent grievances, it is important to acknowledge that conflicts and grievances may emerge because of human involvement. Form Ghana has implemented a specific Grievance Redress Mechanism (GRM), outlined in protocol P7¹³, to address conflicts and

¹³ Internal document, Form Ghana, P 07 Grievance Redress Mechanism.docx

grievances. This approach governs all interactions with stakeholders and workers. The GRM's operation and accessibility is a recurring subject in stakeholder meetings

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

Background to the implementation status: The objective of the project is to carry out reforestation of 20,000 hectares in degraded forest reserves located in Ghana. As of 31 July 2023, an area of 1,373 hectares in the Asubima Forest Reserve has been reforested, as part of the first instance. The second instance of the grouped project started on 1st March 2011, resulting in the reforestation of 1,802 hectares in Afrensu Brohuma Forest Reserve. The third instance of the grouped project commenced on 1st March 2013, and 8,908 hectares have been planted in the Tain II Forest reserve.

No new project areas have been established. No new instances were added to the project in the monitoring period between August 2021 and July 2023.

During the monitoring period, a key modification was made by incorporating the regions that were planted between the years 2021 and 2022 into the Tain II Forest Reserve (Berekum). This area is managed as a distinct entity, alongside the areas that were previously planted in the Asubima and Afrenso Brohuma Forest Reserve. A portion of the project area, which comprises the Asubima and Afrenso Brohuma Forest Reserve, is within the ambit of the FSC certification. However, no new areas have been established within this segment of the project area. Routine management activities, such as pruning, thinning, and forest preservation, have been performed as is the normal practice. The monitoring system defined in the PDD is utilized to systematically evaluate risks.

No events occurred during the monitoring period that impacted on GHG emissions and/or monitoring.

No changes to the project proponent or other entities occurred during the monitoring period.

The following activities take place in the various areas and are provided below to give context to the project.

Activity	Description
Planting	Planting is on-going.
Beating up (Blanking)	A few months (August / September) after planting the mortality rate is assessed. This assessment was done using row counts, where for at least four lines per block the survival was counted. Once the survival was less than 80%, beating up is carried out.

Activity	Description
Singling	Teak and Gmelina stumps have the remarkable ability to grow multiple stems. However, to ensure optimal growth and development, it is recommended to remove the extra stems about one year after planting. This process is carried out meticulously with secateurs, not cutlasses, and is accompanied by weeding. As the plant matures, singling is done whenever forked or multiple stems are formed, and this is achieved using chainsaws before pruning. It is important to note that singling should not be carried out above breast height due to safety reasons. During the monitoring period, singling was carried out after planting, but this practice is not applicable to indigenous areas. Overall, these carefully executed methods ensure that Teak and Gmelina stumps achieve their full potential and provide sustainable benefits.
Weeding	Weeding is an important aspect of forest management and is typically carried out at least twice a year before canopy closure. The process is undertaken manually using cutlasses, with two methods employed: full weeding and circle weeding. Circle weeding involves removing vegetation in a radius of one meter around the planted tree and from the base of the tree. Glyphosate-based herbicides are also applied to further control weeds, which are not considered highly hazardous chemicals by FSC. Depending on the weed pressure, Glyphosate-based herbicides are used after manual weeding for optimal effect. During the monitoring period in both Asubima and Afrensu Brohuma FRs (Akumadan) and Tain II FR (Berekum), both manual and total weeding were carried out.
Pruning	Pruning is a crucial practice in forestry to promote timber quality and yield. It involves the removal of side branches along the stem of the tree, up to a maximum height of 1/3 of the tree's total height. This height is determined per block, based on the observed average tree height during the time of pruning. The first pruning is conducted three years after planting, followed by subsequent prunings at years five and seven. It is important to note that pruning is conducted during the dry season to allow for the drying of pruning wounds, which helps prevent infestation from fungi. To ensure precision and accuracy, pruning is carried out using sharp pruning saws or secateurs and not with cutlasses. During the monitoring period, pruning was conducted in Asubima, Afrensu Brohuma FRs (Akumadan), and Tain II FR (Berekum), and it is noteworthy that this practice does not apply to indigenous areas.
Thinning	Thinning is done to optimize diameter growth and minimize excess biomass. Thinning was carried out in all plantations during the monitoring period. Commercial thinning is only carried out in the teak and Gmelina areas.
	Form Ghana takes security very seriously and has put in place measures to ensure that all activities within and around the plantation are closely monitored. The security guards are responsible for this task and are strategically placed to ensure that they have a clear view of the entire plantation.

Activity	Description
Plantation Protection (illegal activities and fire)	Rapid response fire teams are also stationed at strategic areas within the plantation, with one backup team always patrolling the plantation. The manned watchtowers and camera system provide an added layer of security, enabling the security team to monitor all activities and take appropriate action when necessary. In addition, Form Ghana enforces a no-fire rule in the plantations and identifies high-risk areas to prevent fire outbreaks. Fuel reduction activities are also carried out to reduce fire risk. These efforts have been successful, as Form Ghana did not lose any of its plantations to fire throughout the monitoring period. Form Ghana has boom gates at different locations within plantations which serve as access control. Security guards monitor and report all illegal activities to management.
Conservation measures	The environmental impact assessment conducted by Form Ghana prior to the establishment of plantations revealed that the semi-dry deciduous forest, once abundant in the area, has been significantly degraded with only small patches remaining. The current vegetation is a mosaic of savannah, agricultural land, unmanaged teak plantations, and degraded forest. The forest remnants are limited to the periphery of streams and rivers. Although some original forest fauna, such as bush pigs and antelopes, still exist, most of the animals encountered during the survey are birds, snakes, and small mammals that are characteristic of savannah vegetation. This assessment underscores the need for sustainable forestry practices and ecosystem restoration efforts. The conservation strategy aimed at restoring degraded forest reserves involves reforestation of select areas and restoration of ecological values. The restoration of tree cover is expected to create a forest climate that will promote carbon storage above and below-ground, nutrient cycling, improved water quality, and establishment of corridors of natural, riparian forest in the form of buffer zones alongside rivers and water bodies. In the Tain II Forest reserve, indigenous areas were selected for planting to ensure forest restoration around the Tain River. In areas with good and intact forests, no action was taken, while enrichment planting was done in some areas and protected against illegal activities and fires. The implementation of this conservation strategy is expected to contribute significantly to the restoration of degraded forest reserves and promote sustainable forest management practices. As part of Form Ghana's monitoring system (see Protocol 13), biodiversity (flora and fauna) studies were carried out in the Akumadan plantations from 15th to 25th March 2021. The two main land cover types were recorded in the study area, these included teak and forest buffers. In summary the study found the highest biodiversity in the forest buffers compared to within the teak plantation. Thus, the forest buffer zones accounted for a large proportion of flora and fauna abundance and diversity. Refer to the report: "2021 Biodiversity monitoring report of Form Ghana's Akumadan teak plantation".

3.2 Deviations

3.2.1 Methodology Deviations

No deviations from the methodologies and tools used during this project were undertaken.

3.2.2 Project Description Deviations

Volume calculations for indigenous trees and stands

In the previous monitoring period (2019 -2021) and in the approved monitoring report for that period, the method of calculating the AGB of indigenous trees and stands in the baseline calculations as well as the monitoring data was changed from the pantropical model to a model specific for tropical forest trees and stands in Ghana, as described by Aabeyir et al. (2020). The parameters in the Aabeyir et al (2020) model was estimated based on trees from stands with a similar species composition and similar climatic circumstances; they can be assumed to be more accurate to our data than the pantropical model used previously. Moreover, the model was based on destructive sampling and thereby on very accurate AGB numbers for the included trees. This change does not impact any other part of the methodology, nor the additionality. The baseline scenario likewise stays the same, with the exception that the baseline values for indigenous trees are affected by the changed AGB formula for indigenous trees.

In the current monitoring report period, the Aabeyir et al (2020) model has been maintained as the method of calculating the AGB of indigenous trees and stands.

The precise methodology changes between these methods are explored in the Project Description Document. Regarding the carbon calculations, values for the new methods are higher than those computed with the old form factor. This is illustrated in the table below:

Table 2: Changes in C_Tree for the crediting period up to present between the two AGB approximations

Plantations	Plant year	C_TREE old method (over whole project duration up to 2021)	C_TREE new method (over whole project duration up to 2021)	Absolute difference	% changes (2019 baseline)
Akumadan	2010	4,348	5,305	957	22.1
Akumadan	2011	18,862	23,006	4,143	22.0
Akumadan	2012	1,107	1,352	245	22.2
Tain II	2013	1,595	1,948	353	22.2
Tain II	2014	7,661	9,356	1,695	22.1
Tain II	2015	3,480	4,244	764	22.0
Tain II	2017	3,006	3,675	669	22.3
Tain II	2018	11,929	14,553	2,624	22.0

As can be seen in the table above, an increase of ~22% in total C_TREE over the whole project period is the result of the implementation of the new volume calculations. This increase is justified by the fact that the model used in Aabeyir et al. (2020) is significantly better suited to

our own data than the pantropical model concerning monitoring area, species composition and climatic circumstances, as noted earlier.

The baseline calculations for the indigenous plantation areas were also heightened by the new AGB calculations; they increased from 8.9 to 10.8 t CO₂e ha⁻¹.

This change does not affect previous credit issuances. The calculated credits for the vintages can be seen as extra conservative through the use of the pantropical AGB model.

Yield prognosis for indigenous stands

Based on analysis of the project's own data it becomes clear that the growth approximation for indigenous was optimistic in the previous reports. We have calculated a new approximation based on a hill function which reduced the predicted growth significantly but is closer to what the data shows us. Since this only concerns the ex-ante carbon storage predictions, this change does not influence carbon storage calculations for credit issuance. A detailed description of the new growth approximation for indigenous trees can be found in the Project Description Document. A detailed description of the new volume calculations and yield prognosis for indigenous trees and stands is found in the project description under paragraph 3.2.2.2.

3.3 Grouped Projects

The eligibility criteria for new instances that join in the Form Ghana grouped project have been described in the Form Ghana VCS Project Description document¹⁴. All potential new project instances must adhere to these criteria. The current project locations are in the south-eastern part of Asubima Forest Reserve, the north-eastern part of Afrensu Brohuma Forest Reserve (these are referred to as Akumadan) and the northeastern part of Tain II reserve (referred to as Berekum) and are considered a grouped project. No new instances were added to the project in the monitoring period between August 2021 and July 2023. The newly planted areas are part of the existing TAIN II (Berekum) instance.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	Allometric constant for aboveground biomass (AGB) and volume formula for indigenous trees ($a_{i,IND}$)
Data unit	-
Description	This converts DBH (diameter at breast height) and height into total aboveground tree biomass or volume.
Source of data	Aabeyir et al., 2020
Value applied	0.058
Justification of choice of data or description of measurement methods and procedures applied	Peer reviewed data specifically for tropical broadleaved tropical trees in Ghana.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	No comments

Data / Parameter	Allometric exponent for aboveground biomass (AGB) and volume formula for indigenous trees ($b_{i,IND}$)
Data unit	-

¹⁴ VCS Form Ghana Project Description 31-07-2021.pdf

Description	This converts DBH (diameter at breast height) and height into total aboveground tree biomass or volume.
Source of data	Aabeyir et al., 2020
Value applied	0.999
Justification of choice of data or description of measurement methods and procedures applied	Peer reviewed data specifically for tropical broadleaved trees in Ghana.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	No comments

Data / Parameter	Average wood density for Indigenous Forest (D_{IND})
Data unit	kg m ⁻³
Description	This is a calculated parameter of the average wood density.
Source of data	The average wood density is determined based on relevant literature (The Wood Explorer, n.d.; Orwa, et al., 2009; IPCC, 2006)
Value applied	458
Justification of choice of data or description of measurement methods and procedures applied	Sample plots in the buffer zones have been laid out and the tree species identified. With various literature an average weighed wood density was calculated and is applied to calculate dry weight (DW) in the indigenous vegetation.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	No comments

Data / Parameter	Root to shoot ratio for mixed tropical broadleaf species (R_{mix})
Data unit	-
Description	Converts the above-ground biomass to the above- and below-ground biomass.
Source of data	(IPCC, 2006)
Value applied	1.22

Justification of choice of data or description of measurement methods and procedures applied	Conservatively selected for moist deciduous indigenous forest as the values for moist deciduous indigenous forests are lower than for dry forest. Average selected of R-values for forest >125 ton dry weight per hectare ($DW\ ha^{-1}$) aboveground and <125 ton dry weight per hectare ($DW\ ha^{-1}$) aboveground, since forest will change gradually from lower than 125 ton ha^{-1} to more than that in the project period.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	This parameter is only applicable to the indigenous forest stands.

Data / Parameter	Carbon fraction indigenous trees (CF_{IND})
Data unit	-
Description	Amount of carbon in dry matter
Source of data	(IPCC, 2006)
Value applied	0.49
Justification of choice of data or description of measurement methods and procedures applied	Default value from IPCC
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	No comments

Data / Parameter	Form factor remnant teak
Data unit	-
Description	Factor to convert cylinder measured from diameter at breast height (DBH) and height to trunk volume. This is derived from sectional measurements by determining the ratio of the tree volume to the volume of a specified geometric solid of similar basal diameter and height
Source of data	Dupuy, 1990
Value applied	0.36
Justification of choice of data or description of	Peer reviewed publication

measurement methods and procedures applied	
Purpose of Data	Calculation of project emissions
Comments	No comments

Data / Parameter	Biomass expansion factor teak (BEF_{TEAK})
Data unit	-
Description	This is Biomass Expansion Factor (BEF) and R in one. Converts trunk biomass to total above and belowground tree biomass.
Source of data	(Kraenzel, et al., 2003)
Value applied	1.53
Justification of choice of data or description of measurement methods and procedures applied	Peer reviewed publication.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	No comments

Data / Parameter	Teak wood density (D_{TEAK})
Data unit	ton m ⁻³
Description	The density for teak to determine dry weight
Source of data	(IPCC, 2003)
Value applied	0.55
Justification of choice of data or description of measurement methods and procedures applied	Peer reviewed publication.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	No comments

Data / Parameter	Carbon fraction Teak (CF_{TEAK})
Data unit	-
Description	Fraction of carbon in dried teak
Source of data	(Kraenzel, et al., 2003)
Value applied	0.495
Justification of choice of data or description of measurement methods and procedures applied	Peer reviewed publication.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	No comments

Data / Parameter	York wood density (D_{YORK})
Data unit	kg m ⁻³
Description	The wood density of <i>Broussonetia papyrifera</i>
Source of data	(Orwa, et al., 2009)
Value applied	506
Justification of choice of data or description of measurement methods and procedures applied	Literature
Purpose of Data	Calculation of baseline emissions
Comments	No comments

Data / Parameter	Cassia wood density (D_{CASSIA})
Data unit	kg m ⁻³
Description	The wood density of <i>Cassia siamea</i>
Source of data	(Mainoo & Ulzen-Appiah, 1996)
Value applied	640
Justification of choice of data or description of measurement methods and procedures applied	Literature

Purpose of Data	Calculation of baseline emissions
Comments	No comments

Data / Parameter	<i>Gmelina</i> wood density ($D_{GMELINA}$)
Data unit	ton m ⁻³
Description	The density for teak to determine dry weight
Source of data	(IPCC, 2003)
Value applied	0.45
Justification of choice of data or description of measurement methods and procedures applied	Peer reviewed publication.
Purpose of Data	Calculation of project emissions
Comments	No comments

Data / Parameter	Biomass expansion factor <i>Gmelina</i> ($BEF_{GMELINA}$)
Data unit	-
Description	Converts trunk biomass to total aboveground tree biomass.
Source of data	Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Version 04.2)
Value applied	1.15
Justification of choice of data or description of measurement methods and procedures applied	Methodology default value
Purpose of Data	Calculation of project emissions
Comments	No comments

Data / Parameter	$SOC_{REF,i}$
Data unit	ton C ha ⁻¹
Description	Reference soil organic carbon stock

Source of data	CDM “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”, version 01.1.0, Table 3
Value applied	41
Justification of choice of data or description of measurement methods and procedures applied	Average between dry and moist tropical forest as the project lies on the border of the moist forest zone in Ghana. Soil research showed that soils are mostly low activity and therefore all conservatively assumed low activity clay soils (LAC)
Purpose of Data	Calculation of project emissions
Comments	No comments

Data / Parameter	$f_{LU,i}$
Data unit	-
Description	Soil Organic Carbon (SOC) stock change factor for land use
Source of data	CDM “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”, version 01.1.0, Table 4
Value applied	0.70
Justification of choice of data or description of measurement methods and procedures applied	Average between short term and long-term cultivation because the pre-project land use ranges from long term cultivation (>20 years) to short term cultivation (between 0 and 20 years). Following determination of $SOC_{REF,i}$ also an average is applied between dry and moist tropical forest.
Purpose of Data	Calculation of project emissions
Comments	No comments

Data / Parameter	$f_{MG,i}$
Data unit	-
Description	Soil Organic Carbon (SOC) stock change factor for management regime
Source of data	CDM “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”, version 01.1.0, Table 4
Value applied	1.12
Justification of choice of data or description of	Pre-project land use management is ‘reduced tillage’, since farming is characterized by low intensity and reduced soil disturbance.

measurement methods and procedures applied	Following determination of $SOC_{REF,i}$ also an average is applied between dry and moist tropical forest
Purpose of Data	Calculation of project emissions
Comments	No comments

Data / Parameter	$f_{IN,i}$
Data unit	-
Description	Soil Organic Carbon (SOC) stock change factor for input of organic matter
Source of data	CDM “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”, version 01.1.0, Table 4
Value applied	0.935
Justification of choice of data or description of measurement methods and procedures applied	Inputs are low since residues are removed via collection and the land is burned afterwards.
Purpose of Data	Calculation of project emissions
Comments	No comments

Data / Parameter	Constant to convert biomass to age for mixed tropical trees ($a50_{age,IND}$)
Data unit	years
Description	Converts biomass to stand age (or vice versa) as one of two used parameters and is an indicator of the age at which halve of the biomass in a stand has been acquired.
Source of data	(Chazdon et al., 2016)
Value applied	25
Justification of choice of data or description of measurement methods and procedures applied	Estimated from peer reviewed literature regarding biomass accumulation in regenerating forests in Africa (Lewis et al., 2013).
Purpose of Data	Calculation of biomass accumulation prognosis for indigenous stands
Comments	

4.2 Data and Parameters Monitored

Data / Parameter	Constant to convert biomass to age for mixed tropical trees ($a_{age,IND}$)
Data unit	t CO ₂ e ha ⁻¹
Description	Converts biomass to stand age (or vice versa) as one of two used parameters and is an indicator of the aboveground biomass (AGB) in an old growth forest.
Source of data	(Chazdon et al., 2016)
Description of measurement methods and procedures to be applied	Estimated by fitting the model from Chazdon et al. (2016) to the PSP monitoring data from 2023.
Frequency of monitoring/recording	Every year, based on the yearly monitoring data.
Value monitored	26.114
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of biomass accumulation prognosis for indigenous stands
Calculation method	Estimated based on the monitoring data by setting the parameter at random, calculating the summed squared residuals of the monitoring data (see 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx, tab Ind & buffer biomass prognosis, Cell O5) vs. the model data and then minimizing the residuals using the Excel solver (see 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx, tab Ind & buffer biomass prognosis)
Comments	

Data / Parameter	Form factor teak (f_{teak})
Data unit	-
Description	Factor to convert cylinder measured from diameter at breast height (DBH) and height to trunk volume

Source of data	Calculated from section measurements in PP plantations. Equation obtained from literature (Burkhart & Tomé, 2012)
Description of measurement methods and procedures to be applied	For a selection of trees felled in thinning operations among others the DBH is measured at 1m intervals. Section measurements are carried out according to PP's protocol 13.
Frequency of monitoring/recording	Section analysis is done during every thinning operation in the plant year where thinning takes place.
Value monitored	Value depends on tree dimensions of DBH and height of the trees that are felled for the sectional measurements in the thinning.
Monitoring equipment	Caliper and measurement tape
QA/QC procedures to be applied	PP's protocol 13 for monitoring is implemented, including training of the monitoring team
Purpose of the data	Calculation of project emissions
Calculation method	The following formula is used to calculate tree volume, based on which the form factor can be calculated: $\ln(V) = b_1 + b_2 \ln(d) + b_3 \ln(h)$ $b_1 = -9,605$ $b_2 = 1,955$ $b_3 = 0,799$ The form factor is the fraction of the tree volume as a function of cylinder volume for the same DBH and Height dimensions.
Comments	Volume equation was applied to each tree monitored as outlined in the monitoring protocol and according to the Growth model (See Form Ghana model V2). No thinnings were done during the monitoring period and the next section analysis is due in 2024 which will also facilitate the updating of the growth model.

Data / Parameter	$A^{PLOT \cdot i}$
Data unit	ha
Description	Total area of sample plots
Source of data	PP field monitoring (raw data files)

Description of measurement methods and procedures to be applied	See chapter 4.3 of the PDD
Frequency of monitoring/recording	Annually
Value monitored	Aim is to sample 1% of the stratum area Asubima and Afrensu Brohuma Reserve (Akumadan): 418 circular plots of 800 square metres each = 33.4 ha which is 1.15% of the stratum area Tain II Reserve (Berekum) 1043 plots of 729 square metres each = 76 ha which is 1% of the stratum area
Monitoring equipment	GPS, measuring tape.
QA/QC procedures to be applied	Internal auditing on determining plot size by field monitoring teams
Purpose of the data	Calculation of project emissions
Calculation method	Plot size X number of plots
Comments	See 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx – EP tabs, Columns Z and AD in EP C _TEAK and Column L in EP C_INDIGENOUS)

Data / Parameter	H
Data unit	m
Description	Total height of the trees
Source of data	Measured by project proponent
Description of measurement methods and procedures to be applied	Is measured in permanent sample plots, see chapter 4.3 of the PDD for elaboration.
Frequency of monitoring/recording	Annually
Value monitored	Depending on age between 0,5 and 30 meters
Monitoring equipment	Suunto Inclinator PM5: accuracy +/- 1m for trees more than 10 meters high. +/- 1 m

	Measuring pole for trees under 10 meters high. Accuracy +/- 25cm Measuring tape for tree under 2 meters high. Accuracy +/- 5 cm
QA/QC procedures to be applied	Remeasurement of 5% of the trees is done as quality control during internal audit and check of correct implementation of procedures by monitoring team.
Purpose of the data	Calculation of project emissions
Calculation method	Not applicable
Comments	

Data / Parameter	DBH
Data unit	cm
Description	Diameter of the tree at 1,3m height
Source of data	Measured by project proponent
Description of measurement methods and procedures to be applied	Is measured in permanent sample plots, see chapter 4.3 of the PDD for elaboration.
Frequency of monitoring/recording	Annually
Value monitored	Depending on age, between 0 and 45 cm
Monitoring equipment	Diameter tape is used for accurate measurements. Accuracy +/- 1mm
QA/QC procedures to be applied	Remeasurement of 5% of the trees is done as quality control during internal audit and check of correct implementation of procedures by monitoring team.
Purpose of the data	Calculation of project emissions
Calculation method	Not applicable
Comments	

4.3 Monitoring Plan

a. Introduction

Project activities comprise CO₂ sequestration in tree plantations with exotic and indigenous tree species, natural forest restoration in riparian buffer zones and harvesting of high-quality timber. Project activities are carried out and monitored according to approved project methodology AR-ACM0003: *Afforestation and reforestation of lands except wetlands --- Version 02.0* for a project period of 40 years.

Forest health monitoring is conducted across various forest types, comprising commercial plantations featuring Teak and Gmelina, indigenous plantations, and buffer zones. The evaluation is carried out in permanent sample plots (PSP) that are set up across the project area, encompassing diverse forest stands. As a routine practice, additional plots are established in newly planted areas every year, resulting in a progressive increase in the number of plots.

b. Updating of strata

An evaluation is conducted for every verification event to determine whether there is a requirement to modify or revise the current strata. Instances that may necessitate a modification of strata include unforeseen disruptions or management actions that have caused variations in an otherwise uniform stratum. Additionally, the potential to merge strata is also evaluated.

Until now, it has not been necessary to modify strata.

c. Teak / Gmelina plantation strata and PSPs

Teak and Gmelina plantations are stratified based on plant year, and Permanently Sampled Plots (PSPs) are allocated per stratum using a GIS-based allocation procedure. The cumulative area of PSPs is maintained at least a minimum of 1% for each stratum and overall. During monitoring, the maximum allowable relative margin of error of the mean for the estimation of tree biomass is 10% at a 90% confidence level. The layout and size of PSPs vary per plantation and are recorded per plot in the PSP database. At a sampling density of 1%, there is approximately one PSP for every 7-8 hectares of plantation. GPS coordinates are obtained from the GIS procedure and shared with the field monitoring team, along with a plantation map containing all PSPs. Each plant year is monitored every two years, starting from the third year after planting, when establishing a Diameter at Breast Height (DBH) is possible.

d. Indigenous plantation PSPs

The monitoring procedures for indigenous plantation PSP are identical to those for Teak plantations. Nonetheless, the sampling density is set at 2%, signifying that the PSP area amounts to 2% of the entire indigenous plantation area, both per stratum and overall. Such a

higher percentage is required due to the mixed species present in the plantation, resulting in greater variability. A biennial monitoring cycle is employed for each plant year (therefore every 2 years), commencing in the third year following planting, as it is at this stage that a DBH can typically be established.

e. Buffer zones

As previously described in the Project Design Document (VCS Form Ghana Project Description 31-07-2021.pdf, Section 1.8), the buffer zones are categorized into degraded forest buffer and planted buffers. The procedures employed are identical to those used in indigenous plantation. Considering the anticipated homogeneity level, the sampling density aimed for is 2%. The buffer zones are subject to monitoring every five years.

f. Environmental monitoring

Form Ghana places a significant emphasis on environmental values. As a result, the organization conducts monitoring activities related to flora and fauna, water quality, and erosion.

Several staff are involved in the monitoring of the plantations and buffer zones. They are listed in the table below, including their specific tasks and responsibilities.

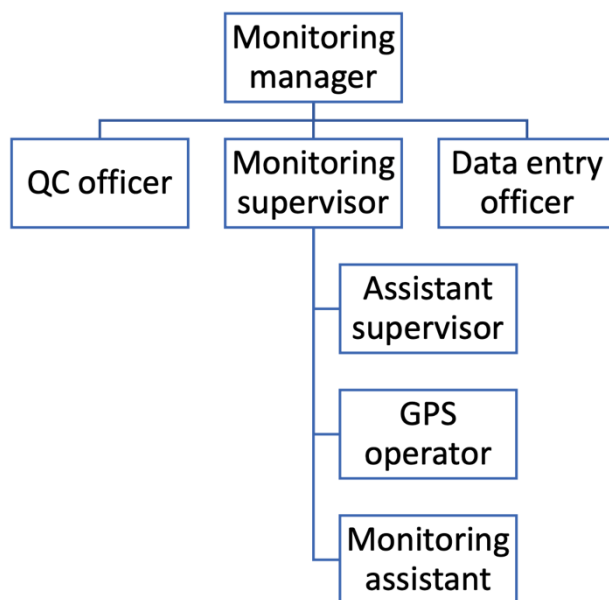


Table 5: Staff employed during the monitoring period with forestry expertise.

Staff	Responsibility	Task
Monitoring manager	Quality assurance of PSP monitoring	Planning and management of the monitoring process

Staff	Responsibility	Task
	Data analysis and reporting to FORM Ghana management	Training of dedicated personnel
Monitoring supervisor	• Correct implementation of PSP measurements • Clear and correct recording on field sheets Maintenance and completeness of equipment • Correct and timely data entry • Report progress	• Supervise implementation of PSP measurements • Recording on field sheets • Supervise correct data entry • Archiving of field data (on paper and digital) • Report/send progress and data updates to the monitoring manager
Assistant supervisor	○ Clear and correct recording on field sheets ○ Correct implementation of PSP measurements ○ Maintenance and completeness of equipment ○ Report progress and updates to monitoring supervisor	• Assist supervision of field teams • Recording on field sheets • Deliver field data to monitoring supervisor
GPS operator	○ Correct operation of the GPS ○ Safe keeping of the GPS ○ Taking correct measurements	○ Localizing PSPs and navigating the field team ○ Erection of poles and numbered tags of new PSPs at the correct GPS position. ○ Assisting in plot measurements
Monitoring assistant	○ Taking correct measurements ○ Provide easy access in and between PSPs	○ Assisting in plot measurements ○ Clearing of PSP where necessary
Data entry officer	○ Correct data entries ○ Timely provision of data updates to the ○ monitoring supervisor	○ Entering data from field sheets into the correct Excel data formats ○ Sending data updates to Monitoring supervisor
Quality control officer	Quality control	Carry out quality control on field measurements and data entry

g. Recording, storing and aggregating data on parameters**g.1 Field measurement procedures for Akumadan**

The process of recording, storing, and aggregating data on parameters of field measurements procedure in Akumadan involves several methods. The PSPs are evaluated annually through a specific procedure.

- The basic shape of a PSP is circular, with a pole placed at the center.
- The site location is determined using GPS coordinates obtained from the GIS system.
- The PSP size is usually 800m², and the plot radius required to achieve this area is 15.96m.
- The plot is laid out by measuring the radius with a tape in eight directions and marking the trees in the plot with paint.
- The plot size remains the same for all plantation ages and stem densities. In case the plot is on a slope, additional guidance should be followed as stated in PP's protocol 13.

g.2 Field measurement procedures for Tain II (Berekum)

On an annual basis, the assessment of PSPs follows a specific procedure.

- The basic shape for PSPs is square plots with poles located at each of the four corners.
- Any decayed poles and tags are replaced prior to assessment.
- The plots are made up of 9x9 planting positions, with a planting density of 3x3m.
- Assuming equal spacing, this results in a PSP size of 729m², with each side of the square measuring 27m in length.
- To mark the plot, five poles are placed, with four located on the corners and one to indicate the direction of the first line of trees to be monitored (as depicted in Figure below).

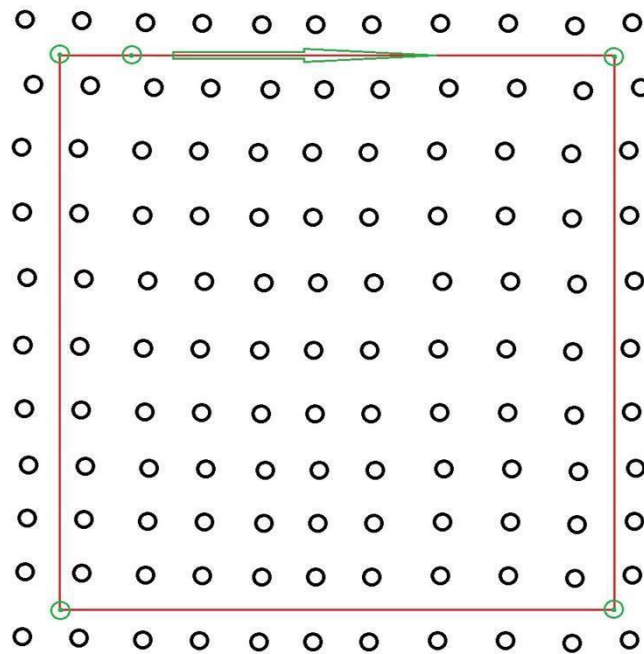
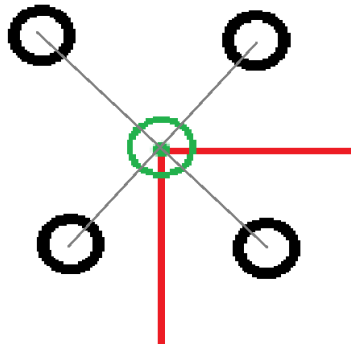


Figure 4: Design Permanent Sample Plots Tain II (Berekum)

- The corner poles must be placed at a specific point in the center of a cross formed between four trees. (see below)



- The GPS point is taken from the corner post to position the plot on GIS and calculate the plot surface.
- Finally, the distance between the poles is measured once the corner posts have been placed. This will later help the GIS to test if the coordinates were correct. The trees on the edge of the plot must be marked with paint, so it is clear what is inside and outside of the plot.

The measurements to be taken in the PSPs are:

A. General data

- Plot number,
- GPS coordinates,
- Date of measurement,
- Crew members taking the measurements.

B. Terrain and soil

- Slope (inclination): with a clinometer the slope of the plot area is measured and recorded. This recording is only done in the first monitoring year.
- Soil depth: With a soil auger (Edelman type) and / or a spade the effective soil depth is determined to a maximum soil depth of 120 cm. Effective soil depth is the depth to which roots can grow unhindered. Gravel or other impenetrable soil layers limit effective rooting depth, and the start of such layer is recorded as soil depth. This recording is only done in the first monitoring year.
- Soil erosion: any visual sign of erosion will be noted descriptively, especially washed away soil.

C. Undergrowth/weeds

- Plant species or type, coverage (%) and height range (m) is noted plant types covering at least 15% of the PSP area.
- For qualifying quantities of Acheampong, York and agricultural crops the species is recorded.
- For qualifying quantities of grass or herbs record only 'grass' or 'herbs'
- Coverage of each plant species or type is estimated as percentage of PSP cover.
- The height or height range is measured per plant species or type.

D. Teak / Gmelina trees

- Qualifying trees are commercial trees that have been planted, as well as wildlings and coppice of this species.
- Tree DBH (diameter at breast height, measured at 1.3m above ground level).
- Height: The height of all trees is measured as accurately as possible with a clinometer or a (telescopic) measurement pole.
- Tree health, pests, and diseases: record as observation in case a tree is affected by a pest or disease.
- All trees standing in the plot are marked with paint to make sure that it is clear which tree falls in or outside the plot.

E. Other trees

- Other trees are only measured if they are qualified.
- Qualifying trees are trees that were present before plantation establishment. These are remnant, indigenous trees, typically with a DBH >10 cm.
- Tree DBH: From qualifying trees the tree DBH is measured with a caliper. Detailed guidance on these measurements is recorded in PP's protocol 13.

g.3 Indigenous plantation PSPs and buffer zone PSPs

The procedures for monitoring indigenous plantation PSPs and buffer zone PSPs are similar to those for Teak plantations, with a few exceptions. Tree height and DBH of all planted trees are recorded in the same manner as Teak. However, unplanted trees are only measured if they meet certain qualifications, such as having a DBH of ≥ 5 cm and not being York. From qualifying trees, the tree DBH is measured using a diameter tape. Additionally, all trees standing in the plot are marked with paint to ensure clarity regarding which trees fall within or outside of the plot. Detailed guidance on these measurements is recorded in PP's protocol 13.

h. Quality assurance and quality control procedures

To enhance the precision of monitoring data quality, quality assurance and quality control (Qa/Qc) procedures are established in accordance with the International Panel on Climate Change (IPCC) best practice guidelines for Land Use, Land-Use Change and Forestry (LULUCF) (IPCC, 2003).

The following activities are implemented:

- All data sheets are maintained as hard copies categorized by plant year and plot number and retained for a minimum of five years.
- The data entry officer enters data into an Excel-based data entry template.
- The monitoring supervisor scrutinizes the data for any potential typing errors that may have arisen during the process of inputting data from field sheets into the computer. This is done by verifying all physical copies against the digitalized records before submitting them to the monitoring manager. The Excel sheets are thereafter forwarded to the monitoring manager for further analysis.
- Digital data is securely backed up and preserved until at least two years after the crediting period has expired.
- The monitoring manager conducts additional quality control measures on the data by reviewing a range of potential errors, including but not limited to:
 - Absent diameter records for trees taller than 1.3 meters.
 - Extreme values for height (H) and diameter at breast height (DBH) that fall outside the biological potential of the trees. This is verified by applying a 'max min' check to filter the records in the spreadsheet.
 - Highly improbable height-diameter (H/D) ratios. A check for H/D ratio is carried out by filtering the records in the spreadsheet. For plantation trees in the regeneration and pole phases, the ratio should fall between 0.5 and 2.5. Any deviations from this ratio will be scrutinized.
- When possible, errors are identified, a thorough investigation to locate the source of the error

will be conducted. It may be due to incorrect data entry or field measurements. At the request of the monitoring supervisor, problematic records will be reviewed and verified for accuracy. If necessary, a field check or re-measurement will be conducted.

- The training of the monitoring team is crucial and is provided on-site by an experienced monitoring professional annually. The monitoring tasks are assigned to various members of the team, and cross-checks are conducted to ensure adherence to the monitoring protocol.
- An annual internal audit was conducted wherein roughly 10% of permanent sample plots are re-measured. The leader responsible for quality control measurements does not participate in the initial measurements. The re-measured data is compared with the monitoring data to identify any errors, which are expressed as a percentage of all rechecked plots to estimate the measurement error. If the difference exceeds 10%, the cause(s) are identified and addressed in the subsequent training session for continuous improvement of the system's accuracy. To ensure adequate supervision, management, and quality control, two qualified and trained staff members can always perform the duties of monitoring manager and monitoring supervisor, preventing any lack of personnel from affecting the process.

i. **Protocol guidelines**

The activities that lead to the minimization of manual transportation errors are described in more detail in Protocol 13. Data is entered by the data entry officer in an Excel template. He/she sends the data to the monitoring manager for analysis. The monitoring manager checks the data for:

1. Missing DBH records for trees >1.3m high.
2. Extreme values for H and DBH.
3. Deviating height-diameter (H/D) ratios. Common H/D ratio for teak trees is 0.5-2.5.

Quality assurance and quality control (Qa/Qc) procedures are established following IPCC good practice guidance for LULUCF, 2003. Hard copies of data sheets are filed by plant year and plot number and stored at least five years. A backup is made of the digital data.

When potential errors are detected, they are forwarded to the monitoring supervisor for review. The supervisor carefully examines the records to determine whether any inaccuracies occurred during data entry in the field. If necessary, a field check or re-measurement is conducted.

To maintain accuracy and continually improve the system, 5% of the PSPs and entered data are re-measured and re-entered, respectively, on an annual basis. These quality control measures are performed by individuals who were not involved in the initial measurements. The plots to be re-measured are selected at random. However, any plots that exhibit unusual data should be re-measured but excluded from the quality control analysis.

The process of comparing the average DBH and Height per plot of re-entered data with the average of the original monitoring data from the same plots is undertaken. In case the difference exceeds 10%, the cause(s) are identified and included in the next training session.

The re-measurement process is conducted under the supervision of a Form international consultant. The consultant carries the original data to the field to check for inconsistencies. After the re-measurement, the stem density of the original data of planted teak (excluding coppice, wildlings, and indigenous trees) is compared to the stem density of the planted trees in the re-measured data. If the difference in stem density of the planted teak exceeds 10% between the original and re-measured data, a new plot is selected for re-measurement. The Form international consultant analyses the stem density during the visit, resulting in 5% of the total plots being re-measured with an average stem density of planted teak that deviates less than 10% of the original data. These plots are used for analyses of DBH and Height. The difference in DBH and Height of planted teak trees should not exceed the limit of 10% between measured and re-measured data.

The data utilized in the analyses are exclusively the original data. The re-measured data is strictly precluded from being employed in PSP report analyses to avert potential growth disparities between the plots that could adversely impact the data analyses.

j. **Results from 2023 monitoring – internal audit quality control**

Please refer to the following three files as reference (files submitted to the VVB):

- QC and regular measurements correlation-deviations.xlsx.
- Quality control- Internal audit graphs.docx with the graphs (in Figure 6) linked to the actual data.
- average deviations- QC-REG-all.sta, which presents the statistical analysis.

These files are quality control internal audit analysis files and provide the procedures for checking the correlation and deviations between the regular monitoring process and the quality control process.

For monitoring in 2023, the results of the internal audit quality control were as follows:

- In Akumadan 46 teak plots and 3 indigenous plots were measured for Quality Control.
- In Tain II (Berekum) 110 teak plots and 39 indigenous plots were measured for Quality control.
- The Quality control measurements and analysis are focused on 3 parameters: (1) number of trees per plot, (2) tree diameter (DBH), and (3) total tree height.

Findings of the internal audit:

- There were no differences found regarding the number of trees per plot for Teak in either Akumadan or Tain II (Berekum).

- No further investigation into the quality of the measurements of the number of trees per plot was conducted.
- No differences were found for the indigenous plots in the Akumadan area or Tain II (Berekum) area.
- Two possible reasons for the perfect positive correlations on tree counts are that the monitoring teams were provided with an in-field workshop together with the monitoring manager on standardizing the determination of trees per plot, also, the leaders of the monitoring teams were trained on how to check for deviations after which they would consult with the monitoring manager for immediate rectification.

Differences in tree diameter and height are shown in Figure 6. The average differences for both height and diameter also indicate minimal deviations with the mean deviations ranging from 0 to 0.05. Statistically, there is no significant difference between original/regular measurements and quality control measurements.

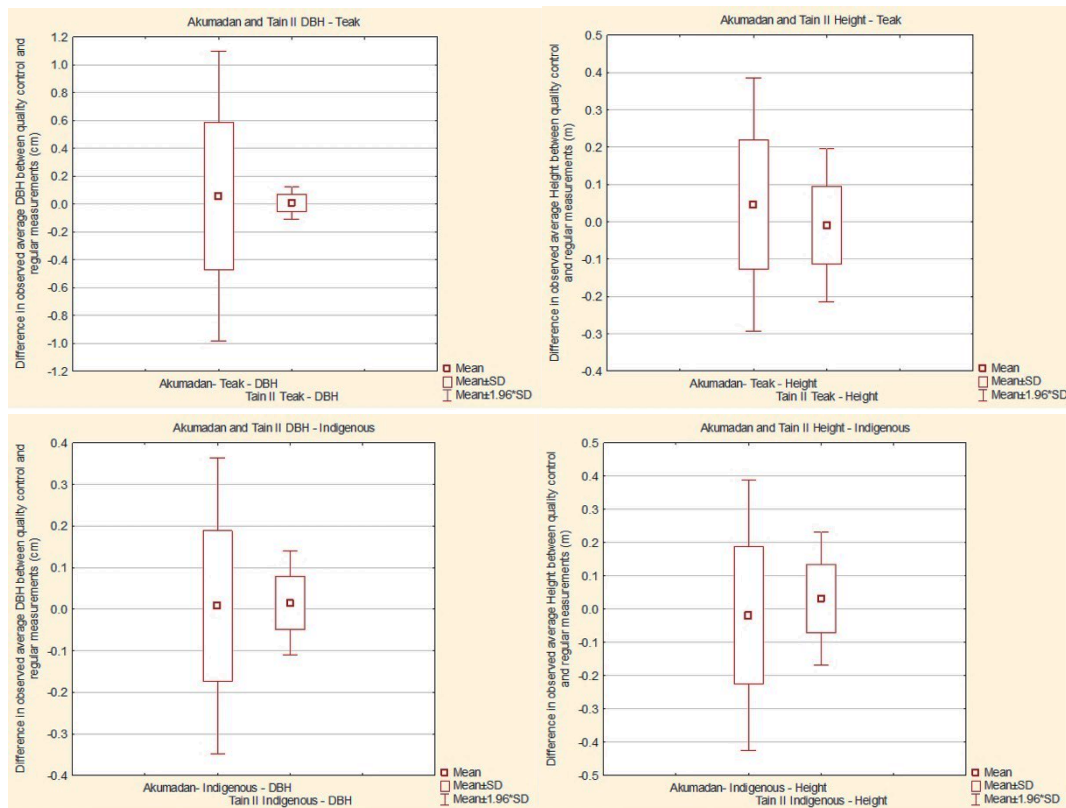


Figure 6: Differences between original measurements and quality control measurements for DBH in Teak, height in Teak, DBH in indigenous trees, and height in indigenous trees.

For the 2023 monitoring data, the following conclusions and points of improvement that had been written up in the previous monitoring periods relating to the control of data entry errors, were implemented:

- In the 2023 spreadsheet, for monitoring dates, separate columns in the excel files were used for year, month, and day. This is to avoid messing up of data due to incorrect or different date formats.
- The following was done for the 2023 monitoring data: Data entry officers check the data entry of their colleagues for a sample of PSPs. All spreadsheets have a quality control checking sheet.
- With data entry attention was paid to replicate data, as e.g., plot numbers or monitoring dates are copied down to other plots. There was constant communication and corrective action feedback between monitoring supervisor and managers as data was submitted as the monitoring progressed.
- For checking missing data in plots and the uncertainty of whether plots were not measured, if data was not captured, or if something else happened. A control mechanism was needed to ensure all existing plots in the measured area are measured and included in the analysis. The control mechanism that worked was continuous data checks as the data was collected. This allowed the monitoring manager to check and rectify mapping and re-identification of plots. This procedure was maintained.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As per the guidelines outlined in ACM0003, carbon stock changes found in dead wood and litter are not to be considered when determining carbon stock changes. Additionally, since shrub biomass is not commonly found in the area, it has been excluded from consideration.

In summary the following should be noted:

Aligned with Section 5, Paragraph 12, AR TOOL 14, V4.2 the changes in carbon stock in the baseline can be accounted as zero.

For accounting the baseline GHG removals the same baseline is considered for the three forest reserves. The change in carbon stock in trees in the baseline can be accounted as zero as condition (g) in Section 5.12 is met (where condition (g) states that Conditions (a), (b) and (c) under paragraph 11 of Section 5 apply:

(a) The pre-project trees are neither harvested, nor cleared, nor removed throughout the crediting period of the project activity. It is confirmed that none of these activities were done in the monitoring period.

(b) The pre-project trees do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the project activity, at any time during the crediting period of the project activity. It is confirmed that pre-project trees did not suffer

mortality because of competition from trees planted in the project, or damage because of implementation of the project activity.

(c) The pre-project trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity. Form Ghana confirms that the pre-project trees are not considered for carbon benefits but are monitored for biodiversity purposes.

Therefore, based on the above assumptions the changes in carbon stocks in the baseline may be accounted as 0.

The baseline net GHG removals are determined as:

$$\Delta C_{BSL,t} = \Delta C_{TREE_BSL,t} \quad (\text{Eq. 1 AR-ACM-0003})$$

Where:

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks in year t; t CO₂-e

$\Delta C_{TREE_BSL,t}$ = Change in carbon stock in baseline tree biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO₂-e

C_{TREE_BSL} at the start of the project activities was determined for two different baseline carbon stock levels, because two clearly distinct strata have been identified with the use of satellite imagery and vegetation sampling. These baseline carbon stock strata are:

- Stratum 1: Mosaic of agricultural land and degraded grasslands with some scattered trees remaining.
- Stratum 2: Patches of degraded forest in the buffer zones along watercourses.

According to the data presented in Tables 6 and 7, it is evident that the woody biomass levels in stratum 1 are significantly lower than those in stratum 2, with a higher percentage of native vegetation remaining. These tables provide insight into the carbon pools of the Tain II (Berekum) and Akumadan plantations for the two baseline carbon stock strata.

Table 6: Baseline carbon stocks determined for the Tain II (Berekum) plantations

Baseline carbon stock stratum	Relevant biomass pool	Value (ton CO ₂ e per ha)
CTREE_BSL_1	Remnant Indigenous Trees (IT) (protected)	20.46
	Remnant Teak (RT) and Invasive Trees (IT) (felled in the project scenario)	0.52

	Total	20.98
CTREE_BSL_2	Remnant Degraded Forest (MDF)	49.81
	Total	70.80

Table 7: Baseline carbon stocks determined for the Akumadan plantations

Baseline carbon stock stratum	Relevant biomass pool	Value (ton CO ₂ e per ha)
<i>CTREE_BSL_1</i>	Remnant Indigenous Trees (IT) (protected)	10.8
	Remnant Teak (RT) and Invasive Trees (IT) (felled in the project scenario)	6.8
	Total	17.6
<i>CTREE_BSL_2</i>	Remnant Degraded Forest (MDF)	119.4
	Invasive Trees (IT)	3.9
	Total	123.3

Remnant Indigenous Trees (RIT), Remnant Teak (RT) and Invasive Trees (IT) (CTREE_BSL_1)

As elaborated in the PDD (VCS Form Ghana Project Description 31-07-2021.pdf), the change in carbon stock in Remnant Indigenous Trees (RIT) is accounted as zero since the trees are protected and excluded from further estimation of project net GHG removals by sink.

The Remnant Teak (RT) and Invasive Trees (IT) are removed during land preparation, although areas where Remnant Teak plantings are conserved and managed by PP are excluded from the project. To accurately estimate the carbon stock in this pool (RT and IT), the number of trees felled for land preparation in the 2013 area were counted and summarized in Appendix I (Annex I VCS calculations Form Ghana 2021 v.2.xlsm) in the previous monitoring report “MON_REP_987_28April2022.pdf”, page 35. The conservativeness of this figure is further verified by land clearing information in subsequent planting years. A weighed estimate of 0.52ton CO₂e ha⁻¹ was obtained (VCS Form Ghana Project Description 31-07-2021.pdf), clearly demonstrating that the applied figure is sufficiently conservative for application in the Tain II Forest Reserve (Berekum) for this stratum.

The same methodology was applied to the Akumadan plantations, where information on carbon stocks from RT and IT were based on felling data covering 1008 hectares from 2008 (the motivation was verified and the argument approved during the previous verification, refer to “MON_REP_987_28April2022.pdf”, Annex 1).

Therefore:

$$\Delta C_{TREE_BSL_t} = 0 \text{ and};$$

$$\Delta C_{BSL,t} = 0 \text{ because of the exclusion of carbon stock changes in dead wood, litter and soil organic carbon, and shrubs hardly present in the area.}$$

Mixed Degraded Forest ($C_{TREE,BSL2}$)

During the environmental study conducted by Oduro and Danquah in 2012 as part of the Social and Environmental Impact Assessment (2015), 13 sample plots of 2500 m² were laid out in baseline carbon stock stratum 2 to determine the carbon stocks of the mixed-degraded forest at the beginning of the project activity. The study recorded various parameters including tree height (H), tree diameter at breast height (DBH) and tree species. The 2021 Project Description Document¹⁵ provided the methods used to calculate the total above ground tree volume of all trees in the sample plots, from which the total aboveground volume per hectare was derived. Appendix I of the previous monitoring report (MON_REP_987_28April2022.pdf) contains an elaboration on the calculations and associated uncertainty. A figure of 41.6ton CO₂e ha⁻¹ was determined for Tain II (Berekum), but due to the calculated uncertainty of 26%, a discount of 75% was applied.

This resulted in a final figure of 49.81ton CO₂e ha⁻¹ for Mixed Degraded Forest in the Tain II (Berekum) plantations.

According to the Tain II (Berekum) and Akumadan plantations, no additional removal of invasive trees takes place in the Mixed Degraded Forest. Any alterations in carbon stock are assessed through standard forest monitoring methods. However, these assessments are not included in the present verification period and are thus not expounded upon in this monitoring report.

In this monitoring report, these baseline carbon stocks for stratum 1 and 2 have been applied for the 2019 and 2020 Tain II Indigenous and Teak planted areas that were monitored for the first time in 2023. Given that monitoring starts 3 years after planting as stated in the monitoring plan.

5.2 Project Emissions

Please refer to Section 3.2.1 of the PDD, VCS Form Ghana Project Description 31-07-2021.pdf, for background to the reforestation typology.

Stratification

¹⁵ VCS Form Ghana Project Description 31-07-2021.pdf

The selected carbon pools mentioned in section 2.3 of the PDD, “VCS Form Ghana Project Description 31-07-2021.pdf”, are applied in all reforestation types. However, different ex-ante calculations for carbon storage apply since there is difference in the management of certain areas. There are three identified types:

Reforestation Type	Baseline Scenario	Clear felling	Selective harvesting	Thinning Pruning Management	Planting	ANR
Teak Plantation (I)	1	Yes	No	Yes	Yes	No
Indigenous Tree Plantation (II)	1	No	No	No	Yes	Yes
Buffer vegetation (III)	2	No	No	No	Yes	Yes
Gmelina Plantation (IV)	1	Yes	No	Yes	Yes	No

1. In the Teak plantation and Gmelina plantation clear felling, thinning and pruning are part of the management and therefore a long-term average is applied.
2. Remnant indigenous trees will not be felled during harvesting operations.
3. In the indigenous plantation and buffer zones there will be no harvesting, no pruning and no commercial thinning.

To further stratify the project, planting year has been considered, as presented in the table below. The project comprises of three distinct reforestation types, namely teak (monoculture, 20-year rotation), Gmelina (monoculture, 12-year rotation), and mixed indigenous trees (restoration, no rotation). The long-term average is determined in accordance with the AFOLU requirements 4.5.5 for areas where harvesting is implemented, such as teak and Gmelina. Clear felling is only carried out within the teak and Gmelina plantation areas, while in the indigenous reforestation areas, silvicultural measures, such as thinning, may be implemented.

Since all emissions such as leakage and all carbon pools are required to be included, the project is first stratified per reforestation typology and then for plant year. For each reforestation typology the methodology AR-ACM0003 version 02.0 is followed.

Comments regarding VCU calculations:

1. Currently, Gmelina is not included in the VCU calculations and is only presented in the strata for completeness. In this monitoring report, VCU calculations are only performed for the teak and indigenous strata.
2. VCU calculations exclude teak planted in 2008, as these areas have reached their LTAs.

Table 8: Stratification

Forest Reserve	Abbreviation	Year	Teak (ha)	Indigenous (ha)	Buffer restoration (ha)
Asubima (Akumadan)	ASU	2008	143.8		
Asubima (Akumadan)	ASU	2009	511.7	-	0.5
Asubima (Akumadan)	ASU	2010	619.5	47.7	9.8
Asubima (Akumadan)	ASU	2021	0.1		
Asubima (Akumadan)	ASU	2022	40.4		
Afrensu Brohuma (Akumadan)	AFR	2011	845.6	181.5	3.9
Afrensu Brohuma (Akumadan)	AFR	2012	691.1	80.4	
Tain II (Berekum)	TAIN	2013	573.8	26.7	44.3
Tain II (Berekum)	TAIN	2014	1849.9	194.2	53.4

Forest Reserve	Abbreviation	Year	Teak (ha)	Indigenous (ha)	Buffer restoration (ha)
Tain II (Berekum)	TAIN	2015	1051.8	93.3	130.3
Tain II (Berekum)	TAIN	2016	87.6	-	33.1
Tain II (Berekum)	TAIN	2017	567	82.6	44.7
Tain II (Berekum)	TAIN	2018	1612.1	306.5	25.2
Tain II (Berekum)	TAIN	2019	858.2	363.1	42
Tain II (Berekum)	TAIN	2020	272.7	302.4	2.2
Tain II (Berekum)	TAIN	2021	138.6	9.8	0.6
Tain II (Berekum)	TAIN	2022	142.4	-	-
Total			10,006.3	1,688.2	390

The Teak and Gmelina Plantation (I and IV) and Indigenous Tree Plantation (II) strata for all planting years are submitted for verification and described in this monitoring report. The Gmelina plantation are not submitted for issuance of credits as per the PDD.

5.2.1 Actual net GHG removals by sinks

The project comprises of three distinct types of reforestations, namely: (1) teak (monoculture, 20-year rotation), (2) Gmelina (monoculture, 12-year rotation), and (3) mixed indigenous trees (restoration, no rotation). To determine the long-term average, AFOLU requirements 4.5.5 are followed for areas where harvesting is implemented (teak and Gmelina). Clear felling is carried out only in the teak and Gmelina plantations, and not in the indigenous reforestation areas. To comply with AFOLU regulations, all emissions, including leakage and carbon pools, are considered. Thus, the project is stratified initially per reforestation typology and subsequently for the plant year. The methodology AR-ACM0003 version 02.0 is adhered to for each reforestation typology.

The estimated net GHG emission removals (t CO₂-e) per year are calculated as:

$$\Delta C_{AR-VCS,t} = \Delta C_{AR-VCS,t_TEAK} + \Delta C_{AR-VCS,t_IND} + \Delta C_{AR-VCS,t_BUFFER} + \Delta C_{AR-VCS,t_GMELINA}$$

Where:

$\Delta C_{AR-VCS,t}$	t CO ₂ -e	Net anthropogenic removals by sink, in year t (ΔC_{AR-CDM} from AR-ACM0003 Equation 5)
$\Delta C_{AR-VCS,t_TEAK}$	t CO ₂ -e	Teak plantation emission removals in year t
$\Delta C_{AR-VCS,t_IND}$	t CO ₂ -e	Indigenous plantation emission removals in year t
$\Delta C_{AR-VCS,t_BUFFER}$	t CO ₂ -e	Buffer zone emission removals in year t
$\Delta C_{AR-VCS,t_GMELINA}$	t CO ₂ -e	Gmelina plantation emission removals in year t

In the following sections, the actual net carbon emissions and removals per hectare are elaborated per carbon pool and per reforestation type.

As is explained in the PDD (VCS Form Ghana Project Description 31-07-2021.pdf), some of the emissions and removals of the selected carbon pools are calculated differently for different reforestation types and some are calculated in the same way for different reforestation types. For example, the calculations for C_{TREE} are different for teak and indigenous forest areas, because different species have different growth, while the change in e.g., soil organic carbon is assumed the same for teak and indigenous plantation.

5.2.1.1 Reforestation type I: Teak Plantation

Background: Every year the plantation expands, and additional teak is planted. The grouped project aims at planting 150 hectares teak per year. The plantation started in 2008 in the most western corner of the original project area in Asubima Forest Reserve. Since rotational harvesting will be done following AFOLU requirement, a long-term average calculation is carried out over two rotation periods. Since the growth of teak varies among the plant years, the long-term average is calculated per plant year. Teak plantation strata generates VCU until the long-term average is reached. When applying the long-term average calculation as required by AFOLU requirement 4.5.5, the long-term average is reached in year 11 post planting.

Actual net GHG removals by sinks ($\Delta C_{ACTUAL,t}$)

From ACM0003 Equation 2, the actual net GHG removals equal the carbon stock increase in the relevant carbon pools minus the GHG emissions within the project boundary.

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t} \quad (\text{Eq. 2 AR-ACM0003})$$

Where:

$\Delta C_{ACTUAL,t}$ Actual net GHG removals by sinks, in year t; t CO₂-e

$\Delta C_{P,t}$	Change in the carbon stocks in the project, occurring in selected carbon pools, in year t; t CO ₂ e
$GHG_{E,t}$	Increase in non-CO ₂ GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t, as estimated in the tool “Estimation of non-CO ₂ GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity”; t CO ₂ -e

As elaborated in the PDD¹⁶ (page 46), the increase in non-CO₂ emissions ($GHG_{E,t}$) = 0, which means that $\Delta C_{ACTUAL,t} = \Delta C_{P,t}$.

Since shrubs, litter and dead wood are conservatively excluded, the only relevant carbon pools are above and belowground tree biomass and soil organic carbon, the following equation is used to determine $\Delta C_{P,t}$.

$$\Delta C_{P,t} = \Delta C_{TREE_PROJ,t} + \Delta SOC_{AL,t}$$

Estimating change in carbon stock in tree biomass ($\Delta C_{TREE_PROJ,t}$)

To estimate the carbon stock in tree biomass at a given point in time, the AR-Tool 14 “*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*”, version 04.2 was used. Under this method, existing data is used in combination with tree growth models to predict the growth and development of trees over time. Under the method applied (difference of two independent stock estimations), the change in carbon stock in trees is estimated as the difference between two successive and independent carbon stock estimations.

In other words, the change in carbon stock in tree biomass for teak and indigenous, is calculated according to the methodological tool by estimating the biomass of each plant year during the period between two points of times. According to the monitoring protocol the monitoring starts 3 years after planting when trees have a size where a DBH can be measured; therefore, the planting years from 2021 to 2023 are not measured for the monitoring purpose. The total tree biomass is calculated based on field measurement in permanent sampling plots by summing the biomass of all individual tree measured in each sample plot. The associated uncertainty in teak strata is less than 10% (table 9), therefore there is no need to apply an uncertainty discount; while the associated uncertainty in indigenous strata is 17.8%, according to the methodological tool the uncertainty discount of 50% is applied.

Because shrub biomass is very low, this pool is excluded, which is the conservative approach. The change in tree biomass is estimated using the following equation:

$$\Delta C_{TREE_PROJ} = C_{TREE,t2} - C_{TREE,t1} \quad (\text{Eq. 1 AR-TOOL14})$$

¹⁶ VCS Form Ghana Project Description 31-07-2021.pdf

Where:

ΔC_{TREE_PROJ} = Change in carbon stock in trees during the period between two points of time t_1 and t_2 ; $t\ CO_2e$
 $C_{TREE,t1}$ = Carbon stock in trees as estimated at time t_1 ; $t\ CO_2e$ = Carbon stock in trees as estimated at time t_2 ; $t\ CO_2e$
 $C_{TREE,t2}$ = Carbon stock in trees as estimated at time t_2 ; $t\ CO_2e$

$$u_{\Delta C} = \frac{\sqrt{(u_1 \times C_{TREE})^2 + ((u_1 \times C_{TREE})^2)}}{|\Delta C_{TREE}|} \quad (\text{Eq. 2 AR-TOOL14})$$

Where:

$u_{\Delta C}$ = Uncertainty in ΔC_{TREE}

u_1 and u_2 = Uncertainties in $C_{TREE,t1}$ and $C_{TREE,t2}$ respectively

The tree biomass in the first year is the same as the baseline biomass in trees (remnant indigenous trees, remnant teak and invasive trees) at the start of the project activity ($C_{TREE_BSL_1}$). The tree biomass cleared (remnant Teak, York and Cassia) during land preparation ($C_{TREE_BSL_1,2} + C_{TREE_BSL_1,3}$), is deducted from the baseline carbon stock and the increment of the planted teak trees (C_{TREE_TEAK}) added.

Therefore:

$$C_{TREE} = C_{TREE_BSL_1} - C_{TREE_BSL_1,2} - C_{TREE_BSL_1,3} + C_{TREE_TEAK}$$

Methods for determining $C_{TREE_BSL_1}$ have been discussed in in the PDD¹⁷, Section 3.1. The remnant indigenous trees are a constant figure where change in carbon stock is conservatively estimated to be zero. As discussed in the baseline, the amount of carbon in this pool is expected to decrease due to anthropogenic factors. The remnant trees are protected in the project area and are therefore expected to grow. However, these trees are conservatively assumed to reach a steady state in year zero and are therefore not monitored for ex post calculation but added as a constant to the total C_{TREE} of the relative stratum. Remnant indigenous are not felled in the project scenario.

For the already verified teak strata during the previous verification, C_{TREE} is used as established in the previous monitoring report¹⁸ for these strata.

For the new teak strata in Tain II (Berekum) no verification has been done before, and therefore the tree biomass which is cleared during land preparation is deducted from the baseline carbon stock. As for the Remnant Indigenous Trees (RIT) change in carbon stock is conservatively assumed to be zero, the baseline carbon stock ($C_{TREE_BSL_1,2} + C_{TREE_BSL_1,3}$) that is removed during land clearing is accounted as $C_{TREE,t1}$. Therefore, for the new teak strata in Tain II (Berekum) the following applies:

¹⁷ VCS Form Ghana Project Description 31-07-2021.pdf

¹⁸ MON_REP_987_28April2022.pdf

$$\text{From } \Delta C_{\text{TREE_PROJ}} = C_{\text{TREE},t2} - C_{\text{TREE},t1} \quad (\text{Eq. 1 AR-TOOL14})$$

$$\Delta C_{\text{TREE_PROJ}} = C_{\text{TREE},t2} - (C_{\text{TREE_BSL}_1,2} + C_{\text{TREE_BSL}_1,3})$$

This calculation assumes that no GHG emission reductions have been realized through teak trees from the planting date till the start of this verification period. This is justified as the carbon stock in teak was far below the carbon stock that has been removed with land clearing, and it can only be determined that the baseline carbon stock is exceeded after 3 years. Before the 3 years there is usually no volume that can be measured because of the size of the trees. Therefore, monitoring usually only starts 3 years after planting as elaborated in PP's protocol 13 'Monitoring' when the trees have a size where a DBH can be measured. Therefore, the planting years 2021 – 2023 have not been measured yet.

As before the 3 years there is no volume that can be measured because of the size of the trees, it is appropriate to apply the following for the teak strata in the Tain II (Berekum) plantations.

$$C_{\text{TREE},t1} = C_{\text{TREE_BSL}_1,2} + C_{\text{TREE_BSL}_1,3}$$

Table 9 contains the total value of $C_{\text{TREE},t1}$ for the different teak strata.

The total tree biomass in teak at $C_{\text{TREE},t2}$ is estimated based on field measurements in Permanent Sample Plots as elaborated in the monitoring plan.

The tree volume is calculated as:

$$V_{\text{TREE,teak}} = \text{EXP } b_1 + b_2 \ln(D) + b_3 \ln(H)$$

Where:

D = measured diameter at breast height

H = measured tree total height

b_1 , b_2 and b_3 are coefficients for the volume growth model developed with section analysis measurements and the values for b_1 , b_2 and b_3 are as follows

$$b_1 = -9,605$$

$$b_2 = 1,955$$

$$b_3 = 0,799$$

According to the methodological tool the amount of tree biomass is estimated using the following equations:

$$B_{\text{TREE},i,\text{teak},p,i} = V_{\text{TREE,teak}} \times D_{\text{TEAK}} \times \text{BEF}_{\text{TEAK}} \times (1 + R_{\text{mix}}) \quad (\text{Eq. 5 AR-TOOL14})$$

Where:

$B_{TREE,l,teak,p,i}$	= Biomass of tree l of species j in sample plot p of stratum i; t.d.m.
$V_{TREE,teak}$	= Stem volume of tree l of species j in sample plot p of stratum i, estimated from the tree dimension(s) as entry data into a volume table or volume equation; m ³
D_{TEAK}	= Density (over-bark) of tree species j; t d.m.m ⁻³
BEF_{TEAK}	= BEF-value, which is based on peer reviewed scientific literature (Kraenzel, et al., 2003), includes roots, and therefore the proportion of the total biomass that accounts for trunk biomass (65.28%) provides for a BEF-value of 1.53 that includes R_{TEAK} .

For teak the value of R_{mix} is 0. This is a conservative approach as $(1+R_{mix})$ is then equal to 1 (which is conservative).

The total tree biomass in a sample plot is calculated by summing the biomass of all individual trees measured in each sample plot. The teak biomass equals the total tree biomass in the sample plot, since other tree species are not taken into consideration.

Tree biomass per hectare in the sample plots is calculated by:

$$b_{TREE,p,i} = \frac{B_{TREE,p,i}}{A_{PLOT,i}} \quad \text{Eq. 1 AR-TOOL14 – Appendix 1}$$

Where:

$b_{TREE,p,i}$	= Tree biomass per hectare in sample plot p of stratum i; t d.m. ha ⁻¹
$B_{TREE,p,i}$	= Tree biomass in sample plot p of stratum i; t d.m.
$A_{PLOT,i}$	= Size of sample plot in stratum i; ha

From page 47 of the “VCS Form Ghana Project Description 19072019.pdf”, it follows that:

$$B_{TEAK} = A \times b_{TEAK} \quad (\text{Eq. 13 AR-TOOL14})$$

And

$$C_{TEAK} = 44/12 \times CF_{TEAK} \times B_{TEAK} \quad (\text{Eq. 12 AR-TOOL14})$$

Where:

$$CF_{TEAK} = \text{Carbon fraction of teak tree biomass; t C (t d.m.)}^{-1}$$

The area of a sample plot is close to 800 m² in Akumadan, as the plot radius is 15.96m. In the Tain II (Berekum) plantations, the plot size is 729 m². Tree biomass per hectare in the sample plots is calculated by dividing the total tree biomass in the sample plot by the size of the plot.

Based on the mean biomass of the plots per stratum, as well as the associated variance, the mean carbon stock in teak (C_{TREE}) within the teak biomass estimation strata and the associated uncertainty (u_C) are estimated following the methodology as described in the PDD. The results are shown in the table below, where the uncertainty in t_1 is obtained from the previous monitoring report (Polinder et al., 2022).

Table 9: Mean tree biomass and associated uncertainty in teak strata

Parameter	Unit	T1	T2	Δt
C_{tree}	tCO _{2e}	693,277 ¹⁹	1,033,785 ²⁰	340,508
u_C		2.3%	1.7%	3.9%

Since the uncertainty in C_{TREE} is less than 10%, there is no need to make C_{TREE} conservative by applying an uncertainty discount. The summary of change in tree biomass in the teak strata is shown in the table below.

Table 10: Change in tree biomass in teak strata

Plantations	Abbreviation	Plant year	$C_{TREE,t1}$	$C_{TREE,t2}$	ΔC_{TREE}
Akumadan	ASU	2008	24,651.7	15,655	-8,986.7
Akumadan	ASU	2009	55,739.8	70,641.1	14,901.3
Akumadan	ASU	2010	57,830.2	78,870.7	21,040.5
Akumadan	AFR	2011	95,704.4	106,805.6	11,101.2
Akumadan	AFR	2012	60,512.9	91,060.8	30,547.9
Tain II (Berekum)	TAIN	2013	74,441.9	94,892.1	20,450.2
Tain II (Berekum)	TAIN	2014	196,856.5	288,939.4	92,082.9
Tain II (Berekum)	TAIN	2015	79,008.5	135,612.1	56,603.6
Tain II	TAIN	2016	4,661.0	9,425.2	4,764.2

¹⁹ Rounded down from 693,277.2

²⁰ Rounded down from 1,033,785.5.

(Berekum)					
Tain II (Berekum)	TAIN	2017	19,161.5	44,139.8	24,978.3
Tain II (Berekum)	TAIN	2018	24,118.1	74,829.7	50,711.6
Tain II (Berekum)	TAIN	2019	448.8	20,126.6	19,677.8
Tain II (Berekum)	TAIN	2020	141.8	2,777.3	2,635.5
Total			693,277.2	1,033,785.5	340,508²¹

Change in Soil Organic Carbon (ΔSOC)

The change in Soil Organic Carbon is estimated using the “Tool for estimation of change in soil organic carbon stock due to the implementation of A/R CDM project activities” (version 01.1.0).

The implementation of this tool is elaborated in the PDD (VCS Form Ghana Project Description 31-07-2021.pdf). The result of applying this tool is a fixed estimate of the change in soil organic carbon stock per year per hectare over a period of twenty years.

The results are summarized in the table below. $\Delta SOC_{AL,t}$ represents the fixed amount of annual carbon storage. The calculation can be found in the guiding excel document. Multiplying the number of years and hectares with the $\Delta SOC_{AL,t}$ results in the amount soil organic carbon change within the teak strata.

Table 11: Change in Soil Organic Carbon in teak plantations

Forest Reserve	Abbreviation	Year	Δ Years	A (ha)	ΔSOC
Asubima (Akumadan)	ASU	2008	2	143.8	730.7
Asubima (Akumadan)	ASU	2009	2	511.7	2,599.2

²¹ 340,508.4 rounded down to 340,508

Forest Reserve	Abbreviation	Year	Δ Years	A (ha)	ΔSOC
Asubima (Akumadan)	ASU	2010	2	619.5	3,147
Afrensu Brohuma (Akumadan)	AFR	2011	2	845.6	4,295.5
Afrensu Brohuma (Akumadan)	AFR	2012	2	691.1	3,510.7
Tain II (Berekum)	TAIN	2013	2	573.8	2,914.8
Tain II (Berekum)	TAIN	2014	2	1,849.9	9,397.5
Tain II (Berekum)	TAIN	2015	2	1,051.8	5,343.3
Tain II (Berekum)	TAIN	2016	2	87.6	445.1
Tain II (Berekum)	TAIN	2017	2	567	2,880.3
Tain II (Berekum)	TAIN	2018	2	1,612.1	8,189.5
Tain II (Berekum)	TAIN	2019	2	858.2	4,359.5
Tain II (Berekum)	TAIN	2020	2	272.7	1385.5
Total				9,684.8	49,198²²

Sum of changes in selected carbon pools ($\Delta C_{P,t}$)

The total change in selected carbon pools in the teak strata is the change in tree biomass and

²² 49,198.7 rounded down to 49,198

soil organic carbon. Total $\Delta C_{P,t}$ is therefore:

$$340,508.4 (\Delta C_{TREE}) + 49,198.7 (\Delta SOC) = 389,707.1 \text{ ton CO}_2\text{e} (\Delta C_{P,t})$$

Since $GHG_{E,t} = 0$, $\Delta C_{ACTUAL,t} = \Delta C_{P,t} = 389,707.1 \text{ ton CO}_2\text{e}$

5.2.1.2 Reforestation type II: Indigenous Plantation

As elaborated in the PDD, $GHG_{E,t} = 0$, which means that $\Delta C_{ACTUAL,t} = \Delta C_{P,t}$. Since shrubs, litter and dead wood are conservatively excluded:

$$\Delta C_{P,t} = \Delta C_{TREE_PROJ,t} + \Delta SOC_{AL,t}$$

Estimating change in carbon stock in tree biomass ($\Delta C_{TREE_PROJ,t}$)

The change in tree biomass is calculated by estimating the biomass in each plant year. The tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" is used to determine tree carbon stock changes. Because shrub biomass is very low, this pool is conservatively excluded. The change in tree biomass is estimated using the following equation:

$$\Delta C_{TREE_PROJ} = C_{TREE,t2} - C_{TREE,t1} \quad (\text{Eq. 1 AR-TOOL14})$$

The tree biomass in the first year is the same as the baseline biomass in trees (remnant indigenous trees, remnant teak and invasive trees) at the start of the project activity ($C_{TREE_BSL_1}$). The tree biomass cleared (remnant teak and invasive trees) during land preparation ($C_{TREE_BSL_1,2} + C_{TREE_BSL_1,3}$), is deducted from the baseline carbon stock and the increment of the planted indigenous trees (C_{TREE_IND}) added.

$$C_{TREE} = C_{TREE_BSL_1} - C_{TREE_BSL_1,2} - C_{TREE_BSL_1,3} + C_{TREE_IND}$$

Methods for determining $C_{TREE_BSL_1}$ have been discussed in the PDD. The remnant indigenous trees is a constant figure. As discussed in the baseline, the amount of carbon in this pool is expected to decrease due to anthropogenic factors. These trees are protected in the project area and are therefore expected to grow. However, these trees are conservatively assumed to reach a steady state in year zero and are therefore not monitored for ex-post calculation but added as a constant to the total C_{TREE} of the relative stratum. Remnant indigenous trees will not be felled in the project scenario and there is no intention for harvesting after the crediting period. Silvicultural interventions such as thinning and pruning may take place.

$$C_{TREE,t1} = C_{TREE_BSL_1,2} + C_{TREE_BSL_1}$$

Table 12 shows the total value of $C_{TREE,t1}$ for the different indigenous strata. The total tree biomass in indigenous trees at $C_{TREE,t2}$ is estimated based on field measurements in Permanent Sample Plots as elaborated in the monitoring plan.

The tree volume is calculated according to Aabeyir et al. (2020) as:

$$V_{TREE,ind} = (a_{i,IND} * ((DBH)^2 H)^{b_{i,IND}}) / 1000$$

From the PDD section 3.1.2, the calculation is:

$$V_{TREE_BSL_2,1} = \frac{V_{TREE,indigenous} = (0,058 * ((DHB)^2 H)^{0,999}) / 1000}{A}$$

The Aabeyir volume calculation converts stem biomass to total above ground biomass and therefore only R_{mix} is used in the equation below.

$$B_{TREE_BSL_2,1} = V_{TREE_BSL_2,1} \times D_{IND} \times (1 + R_{mix}) \quad (\text{Eq.5 Appendix 1 AR-TOOL14})$$

$$b_{TREE_BSL_2,1} = \frac{B_{TREE_BSL_2,1}}{A} \quad (\text{Eq.1 Appendix 1 AR-TOOL14})$$

$$C_{TREE_BSL_2,1} = \frac{44}{12} \times CF_{IND} \times b_{TREE_BSL_2,1} \quad (\text{Eq. 12 AR-TOOL14})$$

The precision of the baseline carbon stock is estimated following equation of the CDM tool.

$$u_C = \frac{t_{VAL} \times \sqrt{\sum_{i=1}^M w_i^2 \times \frac{s_i^2}{n_i}}}{b_{TREE}} \quad (\text{Eq. 15 AR-TOOL14})$$

$R_{mix} = 0.22$ as per the IPCC guidelines, 2006, Table 4.4, used in the previous MR calculations (Annex I VCS calculations Form Ghana 2021 v.2.xlsm, Sheet "parameters", and "", Sheet "parameters")

$$(1 + R_{mix}) = 1.22$$

If u_C is greater than 10%, $C_{TREE_BSL_2,1}$ is made conservative by applying uncertainty discount according to the procedure provided in Appendix 2 of the CDM tool. At the time of verification, the uncertainty is calculated again using the number of plots, and a confidence deduction will be applied according to this methodology in case the uncertainty is higher than allowed. This is adopted as the most conservative way to deal with variance in the mixed degraded forests.

According to the methodological tool the amount of tree biomass is estimated using the following equation:

$$B_{TREE_BSL_2,1} = V_{TREE_BSL_2,1} \times D_{IND} \times (1 + R_{mix}) \quad (\text{Eq.5 Appendix 1 AR-TOOL14})$$

The total tree biomass in a sample plot is calculated by summing the biomass of all individual trees measured in each sample plot. Tree biomass per hectare in the sample plots is calculated by dividing the total tree biomass in the sample plot by the size of the plot. The value of $(1 + R_{mix})$ is 1.22.

Based on the mean biomass of the plots per stratum, as well as the associated variance, the mean carbon stock in indigenous plantations (C_{TREE}) within the indigenous biomass estimation strata and the associated uncertainty (u_C) are estimated following the methodology as described in the PDD.

The summary of change in tree biomass in the indigenous strata is shown in the table below.

Table 12: Change in tree biomass in indigenous strata

Plantations	Plant year	$C_{TREE,t1}$	$C_{TREE,t2}$	ΔC_{TREE}
Akumadan	2010	5,304.9	3,099.6	-2,205.3
Akumadan	2011	23,005.6	13,904.3	-9,101.3
Akumadan	2012	1,352.4	1,379.3	26.9
Tain II (Berekum)	2013	1,948.3	3,558.4	1610.1
Tain II (Berekum)	2014	9,356.5	15,192.7	5,836.2
Tain II (Berekum)	2015	4,244.1	2,098.7	-2,145.4
Tain II (Berekum)	2017	3,675.3	4,892.5	1,217.2
Tain II (Berekum)	2018	14,553.0	28,285.5	13,732.5
Tain II (Berekum)	2019	188.8	11,186.4	10,997.6
Tain II (Berekum)	2020	157.2	14,557.9	14,400.6
Total		63,786.1	98,155.1	34,369

Since the uncertainty in C_{TREE} is 17.8%, C_{TREE} is made conservative according to the methodological tool by applying an uncertainty discount of 50%. After application of the

discount ΔC_{TREE} becomes 25,633.2-ton CO₂e. [see 987_Annexure 1-VCS calculations and info- Form Ghana 2023.xlsx, tab EP C TREE INDIGENOUS, cell B26].

Change in Soil Organic Carbon (ΔSOC)

The change in Soil Organic Carbon is estimated using the “Tool for estimation of change in soil organic carbon stock due to the implementation of A/R CDM project activities” (version 01.1.0).

The implementation of this tool is elaborated in the PDD. The result of this tool is a fixed estimate of the change in soil organic carbon stock per year per hectare over a period of twenty years.

The results are summarized in the table below. $\Delta SOC_{AL,t}$ represents the fixed amount of annual carbon storage. The calculation can be found in the guiding excel document [See 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx, tab EP SOC]. Multiplying the number of years and hectares with the $\Delta SOC_{AL,t}$ results in the amount soil organic carbon change within the teak strata.

Table 13: Change in Soil Organic Carbon in indigenous plantations

Forest Reserve	Plant Year	Δ Years	A (ha)	ΔSOC
Asubima	2010	2	47.7	242.2
Afrensu Brohuma	2011	2	181.5	921.9
Afrensu Brohuma	2012	2	80.4	408.6
Tain II (Berekum)	2013	2	25.8	131.2
Tain II (Berekum)	2014	2	194.2	986.5
Tain II (Berekum)	2015	2	63.2	320.9
Tain II (Berekum)	2017	2	62.9	319.3
Tain II (Berekum)	2018	2	242.5	1231.9
Tain II (Berekum)	2019	2	315.9	1604.9

Forest Reserve	Plant Year	Δ Years	A (ha)	Δ SOC
Tain II (Berekum)	2020	2	302.4	1536
Total			1516.4	7703²³

Sum of changes in selected carbon pools ($\Delta C_{P,t}$)

The total change in selected carbon pools in the indigenous strata is the change in tree biomass and soil organic carbon. Total $\Delta C_{P,t}$ is therefore:

$$34,369 (\Delta C_{TREE}) + 7703.5 (\Delta SOC) = 42,072.5 \text{ ton CO}_2\text{e} (\Delta C_{P,t})$$

Since $GHGE,t = 0$, $\Delta C_{ACTUAL,t} = \Delta C_{P,t}$

5.3 Leakage

Under the applicability of AR-ACM0003 the only relevant type of leakage is due to displacement of agricultural activities. There were no agricultural or other activities displaced during the monitoring period. The land available for planting has been leased from the Forestry Commission since 2008 and for the duration of the lease it is agreed that no agricultural activities take place on the areas available for planting. Refer to the lease agreement document "Land lease agreement.pdf". According to Section 2.4 of the agreement it is stated that Form Ghana has to monitor the progress of plantation development within the allocated area. It is Form Ghana's responsibility to ensure that the land is only used for plantation development and that no agricultural activities take place. In Section 3.12 it states that the area cannot be used for any other activities unrelated to plantation development.

$$LK_t = LK_{AGRIC,t} \rightarrow LK = 0 \quad (\text{Eq. 4 AR-ACM0003})$$

As demonstrated in the PDD leakage is deemed de minimis, and therefore set to zero.

The following supporting documentation were submitted and reviewed:

- The benefit sharing agreement and negotiations with the Forestry Commission (refer to the Benefit Sharing Agreement.pdf).
- The land available for planting has been leased from the Forestry Commission since 2008 and for the duration of the lease it is agreed that no agricultural activities take place on the areas available for planting. Refer to the lease agreement document "Land lease agreement.pdf". According to Section 2.4 of the agreement it is stated that Form Ghana has to monitor the progress of plantation development within the allocated area. It is Form Ghana's responsibility to ensure that the land is only used for plantation

²³ 7703.5 rounded down to 7703

development and that no agricultural activities take place. In Section 3.12 it states that the area cannot be used for any other activities unrelated to plantation development.

5.4 Net GHG Emission Reductions and Removals

GHG credits can now be calculated using the following equation:

$$\Delta C_{AR-VCS,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t \quad (\text{Eq. 5 AR-ACM0003})$$

Since $\Delta C_{BSL,t} = 0$ (paragraph 4.1) and $LK_t = 0$ (paragraph 4.3):

$$\Delta C_{AR-VCS,t} = \Delta C_{ACTUAL,t}$$

$\Delta C_{ACTUAL,t}$ has been established in paragraph 4.2.2.

Since $\Delta C_{AR-VCS,t} = \Delta C_{AR-VCS,t_TEAK} + \Delta C_{AR-VCS,t_IND}$ and because GHG emission removals in the buffer vegetation is not included in this monitoring report:

$$\Delta C_{AR-VCS,t} = \Delta C_{AR-VCS,t_TEAK} + \Delta C_{AR-VCS,t_IND}$$

Therefore, $\Delta C_{AR-VCS,t} = 371,107 + 42,072 = 413,179 \text{ t CO}_2\text{e}$ which is the number of generated GHG credits. [see 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx, tab EP Overview, cell I5]

As established in the non-permanence risk report (see 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx, tab EP Overview, cell B9), the risk rating is 10%. This means that 41,318 GHG credits need to be deposited into the AFOLU pooled buffer account. Therefore, a total number of 371,861 GHG credits are eligible to be issued as VCUs for the current monitoring period.

Long-term average

The analysis of the monitoring data results in a calculation of the available VCU eligible for issuance. The same data are also used to calculate the long-term average which is a ceiling for VCU that can be issued for the teak strata. The LTA is calculated based on plantation growth and rotation length. Details are provided in Appendix 1 in sheet EP overview [see 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx, tab EP Overview]. In the table below, the LTA per planting year and the amount of VCU already issued relative to the LTA are presented. The 2009, 2010, and 2013 were approaching 100% in the previous monitoring period (ranging from 86% to 99%). Those planting years have now surpassed the 100% of LTA in this monitoring period and the credits claimed from them are just the remainder to fill the LTA quota. They will not provide credits in the years to come. See 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx. The total long-

term average is currently 1,474,731.22 VCU's [see 987_Annexure 1- VCS calculations and info- Form Ghana 2023.xlsx, tab EP overview, range cell L34 to L47].

Table 14: Summary of LTAs and progress on issuance of VCUs

Year	$\Delta C AR_CDM$ (Total VCU)	LTA ha ⁻¹ (VCU)	LTA total (VCU)	% of LTA
2008	17,011	125.3	18,024.0	98 %
2009	77,321.5	130.6	66,818.7	120 %
2010	83,618.9	139.7	86,544.5	100 %
2011	114,344.1	144.3	121,992	97 %
2012	96,358.1	156.6	108,212	92 %
2013	94,138.5	152.0	87,203.4	111 %
2014	292,092.5	165.6	306,260.7	98 %
2015	136,300	156.7	164,845.6	86 %
2016	7,189	178.1	15,609.7	49 %
2017	41,909.8	170.4	96,595.5	46 %
2018	73,090.2	146.8	236,608.2	34 %
2019	17,177.8	146.8	125,978.6	17 %
2020	2135.5	146.8	40,038.2	9 %
Total	1,083,187.2	150.7	1,474,731.2	77%

The table below presents a summary of the results of this monitoring report, which are divided between the three years (partly) covered by the monitoring period: 2021, 2022 and 2023. Monitoring is a process that takes several months per year and is not in sync with the precise start and end dates of monitoring periods. Consequently, carbon emissions/removals

are calculated for the total monitoring period. The project emissions and removals per year have been calculated by dividing the total carbon benefits between the three years according to the number of months that they represented in the monitoring period. The monitoring period includes 5 months (August - December) in 2021, twelve months in 2022 and seven months in 2023 (January-July), totaling 24 months in the 2021-2023 monitoring period. As such, 5/24 of the total credits was awarded to 2021, 12/24 to 2022 and 7/24 to 2023.

The non-permanence risk report is submitted as a separate document.

The following table presents the net change in carbon stocks, the non-permanence risk rating (as determined in the non-permanence risk report) and the calculated total number of buffer credits that need to be deposited into the AFOLU pooled buffer account.

Table 15: Summary of results

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)	Buffer pool allocation	VCUs eligible for issuance
01-08-2021 – 31-12-2021	0	86,078	0	86,078	8, 607	77,471
01-01-2022 – 31-12-2022	0	206,589	0	206,589	20, 658	185,931
01-01-2023 – 31-07-2023	0	120,510	0	120,510	12, 051	108,459
Total	0	413,179	0	413,179	41,318	371,861

The estimated ex-ante GHG emission reductions and removals and the achieved emission reductions and removals for this monitoring period is presented in the table below. The percentage difference is provided, and the difference is justified. The quantities of GHG emission reductions and removals are the total quantities before any deductions for buffer credits.

<u>Ex-ante emissions reduction s/removals</u>	<u>Achieved emissions reduction s/removals</u>	<u>Percent difference</u>	<u>Justification for the difference</u>
389,884	413,179	6%	The latest Project Design (Table 1 of the VCS Form Ghana Project Description 31-07-2021.pdf) forecasted the following removals: 2021 – 148,320 (based on 5 months August to December) 2022 – 145,394 2023 – 96,170 (based on 7 months January to July) Total: 389,884 The difference between the forecasted figure and the actual removals achieved is because the ex-ante prediction is modeled and therefore a deviation between the model and the actual removals are expected. Form Ghana is aware that the performance of the well managed plantations are better than what the model is predicting and the plan for 2024 is to update the model to provide more accurate growth and removal figures.